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Request for grant of a patent

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1. Your reference	AW/SEB/P/75967.GB/B	
2. Patent application number *(The Patent Office will fill in this part)*	0308909.1	17 APR 2003
3. Full name, address and postcode of the or of each applicant *(underline all surnames)*	INCRO LIMITED 35 Fairfield Rise Wollaston Stourbridge West Midlands DY8 3PQ	
Patents ADP number *(if you know it)*	6463632001	
If the applicant is a corporate body, give the country/state of its incorporation	United Kingdom	
4. Title of the invention	OUTLET DEVICE FOR A CONTAINER	
5. Name of your agent *(if you have one)* "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	WILSON GUNN SKERRETT CHARLES HOUSE 148/9 GREAT CHARLES STREET BIRMINGHAM B3 3HT UNITED KINGDOM	
Patents ADP number *(if you know it)*	7710734001	

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:* *a) any applicant named in part 3 is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body.* *See note (d))*	Yes (a)

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Continuation sheets of this form	
Description	52
Claim *(s)*	
Abstract	
Drawing *(s)*	16 +16

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Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature: Wilson Gunn Skerrett — Date: 16 April 2003

12. Name and daytime telephone number of person to contact in the United Kingdom — Dr A Wells 0121 236 1038

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OUTLET DEVICE FOR A CONTAINER

This invention relates to an outlet device for a container. More particularly, but not exclusively, this invention relates to a nozzle arrangement adapted to be fitted to an outlet of a container so as to enable the release of the contents stored therein to be actuated and controlled.

Nozzles are used for a wide range of applications and, in particular, are commonly fitted to the outlet valve of a pressurised containers, such as a so-called "aerosol canister", to provide a convenient means by which the release of the contents stored in the container can be actuated. So-called pump and trigger nozzle devices are also commonly used to enable the contents of a non-pressurised container to be dispensed in response by the operation of the pump or trigger device.

Following the use of the nozzle arrangement it is common for a proportion of the product to remain within the internal passageway of the nozzle arrangement. This can be a particular problem when the product dispensed through the nozzle is a food product (such as cream, sauces etc.), a cosmetic or pharmaceutical cream or lotion, or an expandable product such as hair mousse, shaving foam etc., because the product retained in the nozzle tends to leak from the outlet over time. As a result, there is a tendency for the product to adhere to and block the outlet of the nozzle arrangement, and either drip down the side of the container or drip onto the surface on which the container is placed. In addition to creating a mess, this leakage can be a

particular problem with products that degrade over time, or products that are prone to microbial contamination. Furthermore, certain products tend to dry out and harden following prolonged exposure to air. This can cause the formation of a hardened residue that can be difficult to remove and could cause the internal passageway and/or outlet of the nozzle arrangement to become blocked.

The problem of leakage occurring from the nozzle following use can arise just by virtue of the effect of gravity causing any product that remains in the nozzle arrangement to flow out through the outlet. Leakage is especially prevalent, however, when the product that is being dispensed through the nozzle arrangement is an expandable product, such as shaving foam or hair mousse, because the proportion of the product which remains within the nozzle arrangement after use tends to expand over time and this effect invariably causes at least a proportion of the product present in the nozzle arrangement to leak out through the outlet.

One approach to solve this problem is to provide a cleanable nozzle arrangement. Examples of such nozzle arrangements are described in WO 97/31841 and WO 01/89958, the entire contents of which are incorporated herein by reference. These nozzle arrangements are formed from two constituent parts, which can be split apart to enable the inside of the arrangement to be accessed for cleaning after use, thereby enabling any product

remaining therein after use to be removed. However, it is neither practicable nor convenient to clean the nozzle arrangement after each instance it is used.

For this reason, there is a desire to seek alternative approaches to alleviate this problem. In particular, is an object of the present invention to provide a nozzle arrangement constructed so that the problems caused by any product remaining in the internal passageway after use is obviated or at least minimised.

As a result of various investigations, a pressure sensitive outlet device was developed which could be used in a whole range of applications, including a use as a nozzle arrangement. Hence, according to a first aspect of the present invention there is provided a pressure-sensitive outlet device adapted to be fitted to an outlet of a container having contents stored therein, said outlet device being configured to enable the contents of said container to be dispensed though said outlet device under pressure and comprising:

(i) an inlet through which the contents of said container access said outlet device during use;

(ii) an outlet through which the contents of said container are ejected from said outlet device during use;

(iii) an internal passageway which connects said inlet to said outlet such that said contents flow through said passageway from said inlet to said outlet during use;

wherein at least a portion said passageway is provided with a resiliently deformable wall, said wall being configured to reside in a position in which said passageway is closed when the device is not in use and to resiliently deform to form an open passageway during use when the contents of the container are caused to flow through said passageway under pressure.

The outlet device of the present invention is, in effect, a pressure sensitive outlet valve which enables the contents of a container to pass through the internal passageway of the device under pressure. However, when the requisite pressure is not applied, i.e. when the device is not in use, the internal passageway is closed by the resiliently deformable wall.

It shall be understood that by "pressure-sensitive outlet device " it is meant a device which allows the contents of a container to flow through the device only when a certain amount of pressure is applied to force the contents through the device. The amount of pressure required to cause flow through the device could be manipulated as desired by varying the resilience provided by the resiliently deformable wall of the internal passageway. This can be achieved by selecting the most appropriate materials and configuration of the resiliently deformable wall to achieve this function.

It must also be appreciated that by "resiliently deformable" we mean that the wall resides in a position in which the internal passageway is closed when no pressure, or insufficient pressure, is applied to cause the contents to flow through the internal passageway, but can deform to provide an open internal

passageway when the contents are caused to flow through the internal passageway under pressure.

The container and/or the outlet device must be provided with a means for applying pressure to cause the contents of the container to flow through the outlet device. The pressure required could simply be the pressure of gravity which causes the contents of the container to flow through the outlet device, for example, when the container provided with the outlet device is turned upside down. Alternatively, the container could be provided with collapsible or "squeezable" walls that can be either collapsed or squeezed by manually or mechanically pushing the walls of the container inwards. However, in most cases the container will be a pressurised container provided with an outlet valve that can be selectively opened to cause the contents of the container to flow through the device.

As previously stated, a particular preferred form of outlet device of the present invention is a nozzle arrangement. Therefore, according to a second aspect of the present invention there is provided a nozzle arrangement suitable for use in actuating and controlling the release of the contents of a container, said nozzle arrangement comprising:

(i) an inlet through which the contents of said container access said nozzle arrangement during use;

(ii) an outlet through which the contents of said container are ejected from said nozzle arrangement during use;

(iii) an internal passageway which connects said inlet to said outlet such that said contents flow through said passageway from said inlet to said outlet during use; and

(iv) a manually operable actuator, said actuator being configured, upon operation, to cause the contents of the container to access said inlet and flow through said passageway and be ejected through said outlet under pressure;

wherein at least a portion said passageway is provided with a resiliently deformable wall which is configured to resiliently deform to form an open passageway during use when the contents of the container are caused to flow through said passageway under pressure and to close said passageway when said nozzle arrangement is not in use.

The nozzle arrangements of the present invention have been found to solve the aforementioned problems associated with known nozzles. Specifically, the provision of an internal passageway which can be opened while a product is being dispensed through the nozzle arrangement, and closed when the nozzle arrangement is not in use, provides a means by which any product that remains within the internal passageway after use can be displaced from the internal passageway. In practice, this occurs as soon as the actuation of the release of the contents of the container has finished and the resiliently deformable wall returns to the position in which the passageway is closed (thereby displacing any product present in the internal passageway). As a

result, the last portion of the material dispensed through the outlet is the portion which would typically remain in the internal passageway of a conventional nozzle arrangement. The majority of the material forced out by the resiliently deformable wall will exit through the outlet, but a small proportion of the product may also be pushed back towards the container.

In addition, there are further advantages associated with the nozzle arrangements of the present invention because the closure of the internal passageway after use provides a substantially airtight seal which prevents any contents of the container that might remain in the internal passageway being exposed to the air and/or microbial contamination. If the contents of the container are, for example, food products or creams or lotions, the formation of a substantially airtight seal can prevent the product from degrading or "going off". In addition to improving the quality of the product ejected through the nozzle arrangement during a subsequent use of the nozzle arrangement, this can also reduce any the occurrence of any adverse smell that may be generated by the degrading product.

Furthermore, because there will usually be virtually no product remaining in the internal passageway of the nozzle arrangements of the present invention, there will not be a sufficient amount of any expandable product remaining in the nozzle which could, following expansion, leak out of the nozzle arrangement.

It shall be appreciated that the term "container" is used herein to denote any container in which the contents or product that is to be dispensed through the outlet device or nozzle arrangement can be stored, and which comprises an outlet through which the contents can be ejected. In most cases, the container will be a typical container or bottle having a body which defines an interior in which contents can be stored an outlet through which the contents can be ejected from the container. However, the term "container" used herein also includes less conventional containers in which the contents to be dispensed may be stored, such as a pipe (e.g. a garden hosepipe), or any other shaped article having an outlet which may contain the contents to be dispensed through the outlet device or nozzle arrangement.

The nozzle arrangement of the present invention may be any suitable form of nozzle arrangement. For example, the nozzle arrangement may be a pump or trigger device which is adapted to be fitted to a non-pressurised container. In such cases, the actuator of the nozzle arrangement is the pump or trigger. The operation of the pump or trigger causes the contents of the container to nozzle arrangement to be dispensed through the nozzle arrangement under pressure. In most cases, however, the container will be a pressurised container, such as a pressurised aerosol canister, and the nozzle arrangement will be adapted to fit to an outlet valve of the container and actuate the release of the product stored in the container. Such nozzle arrangements have an actuator which is configured to selectively engage with an outlet valve

of the container. Where the container is an aerosol canister, it is preferable that the nozzle arrangement is in the form of a spray-through cap. Examples of spray-through cap nozzle arrangements are described in WO 97/31841 and WO 01/89958.

It is an essential feature of the present invention that the internal passageway has a resiliently deformable wall. In certain embodiments of the present invention, it could be the entire wall or walls of the internal passageway which are resiliently deformable. Alternatively, it may be just a portion of the wall. Preferably, the resiliently deformable wall extends over the entire length of the internal passageway or at least a substantial part of the length thereof.

The elasticity/resilience of the resiliently deformable wall may vary along the length of the internal passageway or, alternatively, it may be uniform along the length of the passageway.

It is also preferred that the nozzle arrangement is formed of at least two separable parts, each of said parts having and abutment surface which, when brought into contact with one another, define therebetween at least a portion of the internal passageway of the nozzle arrangement. It is especially preferred that the entire internal passageway together with the outlet and a portion of the inlet are defined between the abutments surfaces of the at least two parts. Examples of such nozzle arrangements are also described in WO 97/31841 and WO 01/89958 referred to above. This construction enables the abutment surfaces to be separated to expose the internal passageway for cleaning if so

desired. In this regard, although the necessity for cleaning is reduced because the amount of product retained in the internal passageway will be virtually negligible, there may still be some residue remaining, especially after prolonged use, so it will still be desirable to be able to clean the internal passageway periodically to prevent any such build up of residue occurring.

A first part of the nozzle arrangement is preferably formed of a rigid moulded plastic material, such as, for example, polypropylene, and the abutment surface of the first part is preferably provided with a groove which, when contacted with the abutment surface of the second part, forms a portion of the wall of the internal passageway. The abutment surface of second part of the nozzle arrangement forms the resiliently deformable wall of the internal passageway when the abutment surfaces of the first and second parts are contacted together. Preferably, a resiliently deformable protruding ridge is provided on the abutment surface of the second part and is shaped so that, when the abutment surfaces of the first and second parts are brought together to form the nozzle arrangement, the ridge is received within and abuts the surface of the groove provided in the abutment surface of the first part. It is preferable that no gaps are present between the surface of the ridge and the groove of the first channel. As a consequence of the aforementioned construction, it will be appreciated that the internal passageway defined between the abutment surfaces of the first and second parts is closed. The protruding ridge on the abutment surface of the second part of the nozzle arrangement preferably extends along

the entire length of the groove formed on the abutment surface of the first part. The ridge shaped protrusion may be made from any suitable resiliently deformable material which can be moulded into the necessary form to be received directly adjacent to the surface of the groove defined of the abutment surface of the first part. Suitable examples of such materials include various types of resiliently deformable rubber, or soft flexible plastic materials, such as flexible polypropylene or flexible polyethylene. The entire second part of the nozzle arrangement may be formed of the same material or, alternatively, may be formed from a different material, such as a rigid moulded plastic (e.g. polypropylene), with just the ridge protrusion being provided in the second part as an insert formed of resiliently deformable material.

During use, the contents of the container are caused to flow through the nozzle arrangement by the operation of the actuator. The operation of the actuator causes the contents to flow into the inlet of the nozzle arrangement under pressure and enter the internal passageway. This causes the resiliently deformable wall of the internal passageway formed by the ridge protrusion provided on the abutment surface of the second part of the nozzle arrangement to deform in such away that it becomes displaced from the wall defined by the groove formed on the abutment surface of the first part of the nozzle arrangement. As a consequence, the internal passageway is effectively caused to open, thereby enabling the contents of the container to flow through the internal passageway and be ejected through the outlet of the nozzle

arrangement. Once the operator ceases the actuation of the release of the contents of the container, then the resiliently deformable wall of the internal passageway returns to its original position where the internal passageway is effectively closed (i.e. the ridge protrusion provided on the abutment surface of the second part is received within and contacts the surface of the groove formed on the abutment surface of the first part). This recoil of the resiliently deformable wall to its original position causes any product which remains in the internal passageway at the time when the actuation has ceased to be forced to flow out through the outlet. In practice, a small proportion the contents of the container that are present in the internal passageway once the actuation has finished will be forced back into the inlet of the nozzle arrangement.

In certain embodiments of the invention, the first part of the nozzle arrangement will be a lower part which fits to the container and to which the second part is fitted to form a "lid" or upper part. The lid or upper part may be small, i.e. just covering the top of the internal passageway or may be large so as to cover all or the majority of the upper surface of the lower part. In the latter case, a large lid would give a softer feel to a user handling the nozzle arrangement.

The second part of the nozzle arrangement may be completely separable from the first part. In such cases, the second part may be held to the first part by clipping onto the base. The clip may comprise one or more male projections

provided on the abutment surface of one of said parts which are received within correspondingly shaped female holes or sockets provided in the other part.

Alternatively, the second part may be connected to the first part may be connected to the first part by a hinge which enables the abutment surfaces of the two parts to be brought together for use and separated for cleaning when desired.

A clip or an alternative securing means may also be provided to retain the first and second parts together.

In some embodiments the two-parts of the nozzle arrangement may be permanently welded together to provide a single unitary structure, especially if the rigid plastic of the first part is formed of the same or similar material to the second part. The weld could be formed by either the application of heat or an ultrasonic welding process.

The two parts may be moulded separately or, more preferably, as a bi-moulding on one machine.

Preferably, the abutment surfaces of the first and second parts additionally comprise a seal which extends around the internal passageway defined by the abutment surfaces as well as the outlet and the inlet defined therebetween. The seal is preferably a horseshoe seal, similar to that described in WO 97/31841 and WO 01/89958 referred to above.

A portion of the seal may also extend across internal passageway thereby ensuring that the internal passageway is provided with an airtight seal when the

nozzle arrangement is not in use. This would be particularly advantageous if the product passing through the nozzle is a product which is prone to degradation by air (such as creams or other food products) or products with a more watery consistency such as soaps or washing up liquids. How this seal may be achieved is described further below in reference to the figures.

In an alternative embodiment, the resiliently deformable wall of the internal passageway may be formed by providing the abutment surface of the second part with a ridge protrusion which is formed from a very thin section of a hardened moulded plastic which could be configured to function in the same manner as the resiliently deformable ridge. The thin plastic portion of the abutment surface of the second part which forms the ridge protrusion could be formed of plastic which is forced to mould into the desired shape so that when the abutment surfaces are brought together the thin plastic ridge fits closely into the groove on the abutment surface of the first part. The thin plastic wall of the internal passageway thus formed will resiliently deform when the nozzle arrangement is in use and return to its original moulded configuration when the nozzle arrangement is not in use.

The portion of the abutment surface of the first part which forms a wall of the internal passageway when the first and second parts are brought together may be a rigid flat surface instead of being provided with a groove as previously mentioned. Where the abutment surface of the first part is flat instead of provided with a groove, the resiliently deformable wall formed by the

abutment surface of the second part of the nozzle arrangement would also be a flat surface rather than a ridge as previously mentioned. Accordingly, when the abutment surfaces of the first and second parts are brought into contact, a closed internal passageway is defined therebetween. In use, the pressure with which the contents of the container enter the nozzle arrangement through the inlet causes the resiliently deformable wall to deform away from the internal wall defined by the abutment surface of the first part thereby forming an open passageway through which the contents can flow to the outlet. After use, the resiliently deformable wall returns to its original configuration in which the internal passageway is closed.

The internal passageway may be of any suitable shape or configuration for the required purpose. In most cases it will be straight, but it could be curved or shaped or be spilt into one or more internal channels. If the product is intended to be ejected from the nozzle arrangement in the form of a spray, the internal passageway may additionally comprise one or more internal spray modifying structures, such as, for example, one or more expansion chambers, inner orifices, venturi chambers, or swirl chambers. The effect of such internal spray modifying structures is described further in WO 01/89958.

If the product dispensed through the nozzle is a viscous liquid or foam, then the internal passageway could be made wider in the vicinity of the outlet to dispense the product in thicker portions (typically referred to as "slugs").

As previously mentioned, the internal passageway may still comprise some residual product in the internal passageway after use. It the product is extremely expandable, then it remains a possibility that some product may still leak out. For this reason, it will be necessary in some embodiments of the invention to provide a resiliently deformable wall which is configured to preferentially deform (i.e. without requiring the same level of pressure as the remainder of the resiliently deformable wall) in certain areas. Preferably, these preferentially deformable areas are displaced from the outlet so that any residual material that does remain in the passageway and does expand excessively will tend to cause these areas to deform so as to effectively provide an internal cavity which retains the product in the internal passageway and prevents it from leaking out through the outlet. Alternatively, or in addition to the preferentially deformable areas of the wall, the resiliently deformable wall could be provided with portions or areas near the outlet that are stronger, i.e. do not deform as readily as the remainder of the wall so as to provide a tight seal to prevent any expandable product leaking out when the nozzle arrangement is not in use and the internal passageway is closed.

In yet a further alternative embodiment, the resiliently deformable wall may be adapted so that its resilience/elasticity is greatest in the region of the internal passageway at, or near to, the inlet end of the internal passageway and the level of the resilience/elasticity may gradually decrease along the length of the passageway towards the outlet. This construction is preferred because, once

the actuation of the release of the contents of the container has finished, the resiliently deformable wall then recoils to its original "non-deformed" configuration preferentially in the region at or near to the inlet and the force of recoil becomes gradually less towards the outlet end of the passageway. As a consequence, any product retained in the passageway is forced towards, and dispensed out of, the outlet in a continuous "flow-like" or peristaltic motion so that substantially all of the product retained in the internal passageway once actuation ceases is dispensed through the outlet. Any means of varying the resilience/elasticity of the resiliently deformable wall along the length of the passageway may be used. An example of one such means is where the thickness of the wall varies along the length of the passageway, i.e. it is thicker at, or nearer to, the inlet and becomes thinner, or the thickness tapers, towards the outlet.

Certain nozzle arrangements currently available are provided with a mesh positioned at or near the outlet. In such nozzle arrangements, the mesh could be formed from hardened material as usual and the resiliently deformable wall could extend right up to the mesh or, alternatively, the mesh could be made of resiliently deformable material by, for example, being moulded integrally with the second or upper part.

A further problem addressed by the present invention involves the provision of simple, cost effective nozzle pump which can be used to dispense fluid from a non-pressurised container. Conventional pump and trigger nozzle

devices are bulky and typically comprise numerous individual components, which are assembled together to form the final nozzle device.

The present invention provides a solution to this problem by providing, in a third aspect, a nozzle arrangement adapted to be fitted to an opening of a container so as to enable fluid stored in said container to be dispensed through said nozzle arrangement during use, said nozzle arrangement having a body which defines an internal chamber having an inlet through which fluid may be drawn into said chamber and an outlet through which fluid present in the chamber may be expelled from the nozzle arrangement, wherein at least part of the body which defines said chamber is resiliently deformable so as to enable the chamber to be deformed from an expanded configuration to a compressed configuration by the application of a pressure, thereby causing the volume of said chamber to decrease and the fluid present in said chamber to be expelled through said outlet, and to enable the chamber to be subsequently returned to the expanded configuration by the removal of the applied pressure, thereby causing the volume of the chamber to increase and cause fluid to be drawn into said chamber through said inlet.

In contrast to conventional pump-action or trigger-operated nozzle devices, the nozzle arrangements according to the third aspect of the present invention provide an inexpensive, simple, convenient and effective means by which a product may be dispensed from a non-pressurised container. Furthermore, it has also been found that the pump nozzles of the present

invention, when compared with the conventional pump and trigger nozzle devices, require up to four times less effort to pump an equivalent volume of fluid.

In order to function optimally, the outlet of the chamber is provided with, or is adapted to function as, a one-way valve. The one-way valve enables product stored in the chamber to be dispensed through the outlet only when a predetermined minimum threshold pressure is achieved within the chamber (as consequence of the deformation of the chamber form the expanded configuration to the compressed configuration), and closes the outlet at all other times to form an airtight seal. The closure of the valve when the pressure in the chamber is below a predetermined minimum threshold value prevents air being sucked back through the outlet into the chamber when the chamber deforms back to the expanded configuration.

Any suitable one-way valve assembly that is capable of forming an airtight seal may be provided in the outlet. Preferably, the outlet consists of a passageway formed between two abutting surfaces, at least one of which is resiliently deformable. The abutting surfaces are adapted to normally be in tight abutment and thus, render the outlet passageway closed. However, when the pressure is increased in the chamber above a predetermined minimum pressure, the resiliently deformable abutment surface deforms away from the opposing abutment surface to define an open passageway through which fluid can flow. The predetermined minimum pressure that is required will depend on

the application concerned and a person skilled in the art will appreciate how to modify the properties of the resiliently deformable surface by the selection of an appropriate resiliently deformable material and varying the manner in which the surface is fabricated (e.g. by the inclusion of strengthening ridges).

It is especially preferred that the resiliently deformable abutment surface, which forms at least a part of the outlet passageway, is integrally formed with the resiliently deformable portion of the body, which defines the chamber.

As indicated above, the outlet valve preferably only permits fluid to flow through the outlet when the pressure of the fluid in the chamber exceeds a predetermined minimum value (an effect known as "pre-compression"). In certain embodiments, the fluid passing though the outlet passageway outlet valve at or above the predetermined pressure may be directed into a spray nozzle passageway, which is fitted to the outlet valve. The spray nozzle passageway preferably consists of two parts prepared from a rigid plastic material, although it may also be formed from a flexible/resiliently deformable or semi-flexible plastic material or a combination of a flexible/resiliently deformable and a rigid plastic in some cases. Each respective part of the spray nozzle passageway preferably comprises an abutment surface which is provided with grooves and/or recesses formed thereon which, when the abutment surfaces contacted together to form the final spray nozzle passageway, align to define an internal passageway through which fluid passing through the outlet

valve can travel prior to being ejected through an outlet orifice in form of a spray. The spray nozzle passageway may optionally comprise one or more internal features adapted to modify the properties of the fluid passing through so as to form a spray having the required droplet characteristics (e.g. droplet size distribution, droplet dispersion etc.). Examples of internal features that may be present include one or more expansion chambers, one or more swirl chambers, one or more internal spray orifices, and one or more venturi chambers. These aforementioned features, and the effect that they impart on the properties of the spray produced, are discussed in WO 01/89958, the entire contents of which are incorporated herein by reference. It shall be appreciated that the provision of the "pre-compression" ensures that the fluid enters the spray nozzle passageway with enough force to generate the required spray.

The spray nozzle passageway may be in the form of a separate unit, which can be inserted into the outlet end of the outlet valve of the chamber to form the outlet of the nozzle arrangement or, more preferably, the spray nozzle passageway may be integrally formed with the body of the nozzle arrangement. The spray nozzle arrangement may also be hinged so as to enable it to be optionally swung into the required position for use and swing out of position when it is not required.

The resiliently deformable material which forms at least a portion of the body defining the chamber and, in preferred embodiments, also forms the resiliently deformable abutment surface of the outlet valve through which fluid

ejected from the chamber passes before entering the spray nozzle passageway, may also extend over the spray nozzle passageway assembly to provide a sealant coating thereto. Alternatively, the resiliently deformable abutment surface of the outlet passageway/valve may stop at the opening to the spray nozzle passageway instead of extending over it. This latter construction enables the two parts of the spray nozzle passageway to be readily accessible so that the two parts can be separated for cleaning, as discussed in WO 97/31841, the entire contents of which are incorporated herein by reference.

Any suitable resiliently deformable material, such as a resiliently deformable plastic or rubber, may be used in the preparation of the nozzle arrangement of the present invention. In addition, the term "resiliently deformable" is also used herein to encompass rigid plastics materials, which are configured in such a way that a resilient deformation may still occur when a pressure is applied (i.e. when the pressure is removed, the material will then return to its original configuration). In other words, the device could be prepared from a standard material such as rigid polypropylene, provided the device is configured to enable the resilient deformation of a part of the body defining the chamber.

Preferably, the edge of the resiliently deformable material, and the resiliently deformable abutment surface in embodiments where the resiliently deformable material forms an abutment surface of the outlet passage/valve, are made very thin, i.e. preferably of the order of 2-5 millimetres thickness. It is

also preferable that the "outlet" end of the channel is thickened to form a tight seal. This enables the outlet passageway to seal preferentially at the "outlet" end and any matter retained in the channel will be sucked back towards the chamber. This reduces any dribbling or foaming of product at the outlet that may otherwise occur after use.

Preferably, the outlet valve has a predetermined minimum threshold pressure, below which the valve is closed and above which the valve will open. In embodiments where the flexible and resiliently deformable part of the outlet passageway/valve is made from a thin plastic material, the resistance may not be sufficient to provide the required minimum pressure threshold. In such cases, a thickened rib of resiliently deformable material, which extends across the passageway, may be provided to provide the necessary strength and resistance in the outlet passageway/valve. Alternatively, a rigid reinforcing rib could be provided above part of the outlet passageway/device.

It is also necessary that the nozzle arrangement is provided with a one-way valve at the inlet to the chamber. This inlet valve is preferably adapted to allow fluid to flow into the chamber through the inlet only when the chamber is returned from the compressed configuration to the expanded configuration, and prevents fluid flowing from the chamber back into the inlet at all other times.

Preferably, the inlet valve is a flap valve consisting of a resiliently deformable flap positioned over the inlet, which is adapted to deform so as to allow fluid to be drawn into the chamber through the inlet when the chamber

returns from the compressed to the expanded configuration, but covers and closes off the inlet at all other times, thereby preventing fluid flowing back from the chamber into the inlet. It is especially preferred that the resiliently deformable flap is formed as an integral extension of the resiliently deformable portion of the body which defines the chamber.

The nozzle arrangement according to the third aspect of the invention may comprise two or more separate chambers. Each individual chamber may draw fluid into the nozzle arrangement through a separate inlet and from different compartments within the same container. Alternatively, one or more of the additional chambers may draw air in from outside the nozzle arrangement. Whether the additional chamber or chambers contain air or some other fluid drawn from a separate compartment within the container, the contents of the two or more chambers can be ejected simultaneously through the outlet by compressing both chambers together. The contents of the respective chambers will then be mixed within the outlet, either on, or prior to, ejection from the nozzle arrangement. It shall be appreciated that varying the relative volumes of the separate chambers can be used to influence the relative proportions of constituents present in the final mixture expelled through the outlet. Furthermore, the outlet passageway may be divided into two or more separate channels, each channel extending from a separate chamber, and each separate channel may feed fluid into a spray nozzle passageway as discussed above where it is mixed prior to ejection.

Where an additional chamber for the expulsion of air is present, it will be appreciated that, once the expulsion of air is complete and the applied pressure is removed thereby allowing the chamber to deform back to its original expanded configuration, more air needs to be drawn into the chamber to replenish that expelled. This can be achieved by either sucking air back in through the outlet (i.e. not providing this additional chamber with an airtight outlet valve) or, more preferably, drawing air in though an inlet hole in the body defining the chamber. In the latter case, the inlet hole is preferably provided with a one-way valve similar to the inlet valve discussed above. This valve will only permit air to be drawn into the chamber and will prevent air being expelled back through the hole when the chamber is compressed.

In most cases, it is desirable to co-eject the air and fluid from the container at approximately the same pressure. This will require the air chamber to be compressed more (e.g. 3-6 times more) than the fluid/liquid-containing chamber. This may be achieved by positioning the chambers so that, when a pressure is applied, the compression of the air-containing chamber occurs preferentially, thereby enabling the air and liquid to be ejected at the same or substantially the same pressure. For example, the air-containing chamber may be positioned behind the liquid-containing chamber so that, when a pressure is applied, the air chamber is compressed first until a stage is reached when both chambers are compressed together.

As an alternative, the nozzle arrangement may also be adapted in such a way that the air pressure may be higher or lower than the liquid pressure, which may be especially beneficial for certain applications.

When two or more separate compartments are present in the nozzle arrangement, it is problematical getting the outlet valve of each chamber to open at the same time. For this reason, it may be preferable that the arrangement is configured so as to enable the application of a pressure to the resiliently deformable portion of the body to facilitate the distortion/opening of the outlet valves at a predetermined point or time.

In alternative embodiments, air and fluid from the container may be present in a single chamber, rather than separate chambers. In such cases, fluid and air is co-ejected and may be mixed as it flows through the outlet. For example, where the outlet comprises an expansion chamber, i.e. a widened chamber positioned in the outlet passageway, the contents ejected from the chamber could be split into separate branches of the channel and enter the expansion chamber at different locations to encourage mixing.

In preferred embodiments according to the third aspect of the invention, the body of the nozzle arrangement consists of two parts, namely a base part and an upper part. The base part is adapted to be fitted to the opening of a container by a suitable means, for example, it may be in the form of a screw-threaded cap that can be screwed onto a neck opening of a container, and is preferably prepared from a rigid plastics material. The base part also preferably

defines the inlet, a portion of the chamber and an abutment surface of the outlet valve. The upper part is made, at least in part, from a resiliently deformable material, which is moulded so as to enable the upper part to be fitted to said base part to define, together with said base part, the chamber and also provide an opposing abutment surface of the outlet valve. Preferably, the upper part also extends within said chamber to form a resiliently deformable flap, which covers the inlet to the chamber and provides the necessary inlet valve.

Preferably, the arrangement is also provided with a lock to prevent the outlet valve from opening accidentally. The lock may be a bar fitted to the base, which can be swung into a position whereby the bar retains the resiliently deformable abutment surface of the upper part in contact with the opposing surface, thereby preventing fluid passing through the outlet if pressure is applied to the chamber.

A sealing engagement between the two parts is also preferable. In particular, it is preferable that the edge of the upper part is provided with a male ridge and the base is provided with a female groove, which forms a sealing engagement with the male ridge, or vice versa.

An end cap may also be fitted to the base or the upper part if required. This end cap may be folded over and fitted over the outlet. Alternatively, the end cap may be separate.

The base and the upper part are preferably moulded together within the same moulding tool in a bi-moulding process. The base may be moulded in a

first stage and the upper part then moulded in a second stage of the operation. The upper part and the base are then fitted together to form the assembled nozzle arrangement.

It is especially preferred that the base is moulded first from a rigid plastic material together with a framework support for the upper part. The framework for the upper part is preferably connected to the base by a hinged or foldable connection member which enables the framework to be folded over and fitted to the base during the assembly of the final product. Prior to folding the framework over and fitting it to the base, however, the framework is over moulded with a compatible flexible, resiliently deformable plastic material. The resiliently deformable plastic material will thus form, in preferred embodiments, an upper wall of the chamber and an abutment surface of the outlet valve. It may also extend over other parts of the nozzle surface to provide a soft-touch feel to the device when it is gripped by an operator. The rigid framework of the upper part may form an outer edge of the upper part, which forms the point of connection with the base and, in embodiments where a spray nozzle passageway is present, the framework may also form an upper abutment surface which contacts a lower abutment surface formed the base to define the spray passageway and outlet orifice. The upper part may be permanently fixed to the base by, for example, ultrasonically welding the two parts together. Alternatively, the resiliently deformable upper part may be configured to fit to the base to form a tight seal in the absence of any welding,

or may be stretched over the base to form an airtight cover. The upper part may also remain separable from the base so that they can be separated during use to enable the chamber and outlet valve to be cleaned.

As an alternative, the flexible, resiliently deformable upper part may be fitted to the base by, for example, fitting the edges of the upper part into a receiving and retaining groove of the base to define said chamber therebetween. Once in place, the framework of rigid material can then be fitted into place to lock the upper part to the base.

As a further alternative, the upper part may be formed entirely from a flexible/resiliently deformable plastic, i.e. no rigid framework is provided.

As yet another further alternative, the upper part and the base may be moulded separately, in separate tools, and then brought together to be assembled into the final nozzle arrangement outside the mould. The two pieces could be configured to snap-fit together to form a sealed connection or, alternatively, the two parts could be welded (e.g. ultrasonically welded) together after assembly.

In another alternative embodiment, the nozzle arrangement is prepared from a "semi-flexible" plastic material. By "semi-flexible" we mean a plastic material that is rigid in nature, but can be resiliently deformed from its original configuration by the application of a pressure and subsequently returned to its original configuration once the applied pressure is removed. Such "flexible yet rigid" plastic materials are used, for example, in the preparation of shampoo

bottles or shower gel containers. The flexibility/resilience of a semi-flexible material is governed in part by the thickness of the section concerned. In the fabrication of a nozzle arrangement of the present invention, the base may be formed from thicker sections of plastic to provide the required rigidity, whereas the upper part may be composed of thinner sections of plastic to provide the necessary deformability characteristics. If necessary, a framework of thicker sections, generally known as support ribs, may be present if extra rigidity is required in certain areas. The advantage of this alternative embodiments is that the entire nozzle arrangement can be moulded from a single plastic material and hence, can be moulded in a single tool in a single moulding operation. Preferably, the upper part is connected to the base via a hinge or foldable connector so that it can be folded over and fitted to the base after moulding to form the assembled nozzle arrangement, as before.

In yet another alternative embodiment, the base and the container may be integrally formed by moulding the base of nozzle arrangement onto the container. The upper part may be moulded for fitting to the base in any of the ways discussed above. The base may, in certain cases, have an inlet opening through which a dip tube can be inserted, or, in other cases, may be adapted for use upside down.

If the base and upper part are to be moulded or welded together, then it is preferable that they are made from compatible materials, e.g. the upper part is made from flexible polypropylene and the base is made from rigid

polypropylene. Alternatively, both the upper part and the base may be made from the same flexible/resiliently deformable material, with the base being strengthened relative to the upper part by making it thicker and/or providing strengthening rods within its structure.

A dip tube may be integrally formed with the base, or alternatively the base may comprise a recess into which a separate dip tube can be fitted. The dip tube enables fluid to be drawn from deep inside the container during use and thus, will be present in virtually all cases.

Alternatively, it may be desirable with some containers, particularly small volume containers, such as glues, perfume bottles and nasal sprays, to omit the dip tube, because the device itself could extend into the container to draw the product into the nozzle arrangement during use, or the container could be inverted to facilitate the dispensing of the fluid present therein.

In some cases, the chamber will be deformed from the expanded configuration to the compressed configuration by the direct application of pressure by an operator's finger or thumb. Alternatively, however, the nozzle arrangement may additionally be provided with trigger actuator connected to the nozzle arrangement, which is adapted so that when the trigger is pulled by an operator, a portion of the trigger actuator engages the resiliently deformable portion of the body configured so as to cause the chamber to deform from the expanded configuration to the compressed configuration and thus, cause the fluid present in the chamber to be expelled through the outlet.

The trigger actuator may be a separate component, which can be mounted to the nozzle arrangement. Preferably, however, the trigger is integrally formed with the nozzle arrangement. It is also preferable that the trigger actuator extends below the outlet in a similar manner to conventional trigger nozzle arrangements, i.e. enabling an operator to grip the nozzle arrangement, point the outlet in the desired direction and dispense fluid by pulling the trigger actuator towards the base of the nozzle arrangement.

The operation of the trigger initiates the compression of the chamber and the contents stored therein. The device may also comprise a second chamber defined by the body, at least a portion of which is resiliently deformable. This second chamber may be positioned between the downwardly extending handle of the trigger and be compressed directly when the trigger is pulled.

Preferably, the trigger actuator is adapted to be fitted to the nozzle arrangement to form a pivotal connection, which enables the trigger to be pulled about its pivot and apply pressure to the resiliently deformable portion of the body, thereby compressing the chamber and causing fluid to be ejected from the chamber through the outlet. Once the pressure applied to the trigger is released the resilience of the compressed chamber then returns the trigger back to its initial position ready to be pulled again. To provide the necessary resilience to the resiliently deformable portion of the chamber, it may be thickened and/or include strengthening ribs that extend across the resiliently deformable body portion. The trigger may also be partially or totally over

moulded with a flexible plastic to provide a softer contact surface and thus, increase the comfort for the operator when it is grasped. Over-moulding with a flexible plastic can also be applied to the back hinge to strengthen it if desired. The trigger may also be provided with a lock which prevents it being pulled and thus, prevents the accidental operation of the nozzle arrangement occurring.

The pivotal connection may be formed at any suitable position. For example, the pivot may be provided at an edge of the upper surface, or more preferably, the pivotal connection may be on the upper surface at a position which is displaced from an edge, for example, near the middle. This latter positioning of the pivotal connection has been found to provide a more natural or "familiar" feel to an operator when the trigger is pulled.

The chamber may be of any form, but is preferably a dome or similar shaped chamber formed on the upper surface of the nozzle arrangement where it is easily accessible for operation by a person using the nozzle. A flattened dome is especially preferred because it reduces the vertical movement of the trigger necessary to compress the chamber formed on the upper surface.

In some cases, the resiliently deformable portion of the body may not be sufficiently resilient to retain its original configuration following deformation. This may be the case where the fluid has a high viscosity and hence tends to resist being drawn into the chamber through the inlet. In such cases, extra resilience can be provided by the positioning of one or more resiliently deformable posts within the chamber, which bend when the chamber is

compressed and serve to urge the deformed portion of the body back to its original configuration once the applied pressure is removed.

Alternatively, a spring may be positioned in the chamber instead of a resiliently deformable post. As with the post, the spring will compress when the wall is deformed and, when the applied pressure is removed, will urge the deformed portion of the body to return to its original configuration and, in doing so, urges the compressed chamber back into its original "non-compressed configuration".

The device may further comprise an air leak through which air can flow to equalise any pressure differential between the interior of the container and the external environment. In some cases, the air leak may simply occur through gaps in the fitting between the nozzle arrangement and the container, but this is not preferred because leakage may occur if the container is inverted. In preferred embodiments, the nozzle arrangement comprises an air leak valve, i.e. a one-way valve which is adapted to permit air flow into the container, but prevent fluid leaking out of the container if it is inverted. Any suitable one-way valve system would suffice.

According to a fourth aspect of the present invention, there is provided a container having a nozzle arrangement as hereinbefore defined fitted to an opening thereof so as to enable the fluid stored in the container to be dispensed from the container through said nozzle arrangement.

How the invention may be put into practice will now be described by way of example only, in reference to the following drawings, in which:

Figure 1 is a diagrammatic illustration showing a side view of a spray-through cap nozzle arrangement according to the present invention;

Figure 2A is a diagrammatic illustration showing a perspective view of the lower part 102 of the spray-through cap nozzle arrangement shown in Figure 1;

Figure 2B is a further diagrammatic illustration showing a perspective view of the lower part 102 of the spray-through cap nozzle arrangement shown in Figure 1;

Figure 2C is a line diagram showing the perspective view of the lower part 102 of the spray-through cap nozzle arrangement shown in Figure 2B;

Figure 2D is a further diagrammatic illustration showing a perspective view of the lower part 102 of the spray-through cap nozzle arrangement shown in Figure 1;

Figure 3A is diagrammatic illustration showing a perspective view of the upper part 103 of the nozzle arrangement shown in Figure 1;

Figure 3B is a diagrammatic illustration showing a perspective view of the upper part 103 of the nozzle arrangement shown in Figure 1;

Figure 3C is an end view of the upper part 103 of the nozzle arrangement shown in Figure 1;

Figure 4 is a perspective view of an embodiment of the nozzle arrangement according to the third aspect of the present invention;

Figure 5 is a perspective view of the base part 401 shown in Figure 4, without the upper part 402 present;

Figure 6 is a perspective view of the upper part 402 shown in Figure 4;

Figure 7A is a cross-sectional view of the nozzle arrangement shown in Figure 4;

Figure 7B is a further cross-sectional view taken along line A-A of Figure 7A;

Figure 8A is a perspective view of a further embodiment of a nozzle arrangement according to the third aspect of the invention in a dissembled configuration;

Figure 8B is a cross-sectional view taken through the embodiment shown in Figure 8A;

Figure 9A is a perspective view of a further embodiment of a nozzle arrangement according to the third aspect of the invention in a dissembled configuration;

Figure 9B is a cross-sectional view taken through the embodiment shown in Figure 9A in an assembled configuration;

Figure 10 is a perspective view of a further embodiment of a nozzle arrangement according to the third aspect of the invention in a dissembled configuration;

Figure 11A is a perspective view of a further embodiment of a nozzle arrangement according to the third aspect of the invention in a dissembled configuration; and

Figure 11B is a cross-sectional view taken through the embodiment shown in Figure 11A.

In the following description of the figures, like reference numerals are used to denote like parts in different figures where appropriate.

Referring to Figure 1, a two-part spray-through cap nozzle arrangement 101 is shown which is adapted to be fitted to the end of a standard cylindrical aerosol canister (not shown). The spray-through cap nozzle arrangement 101 has a lower part 102 and an upper part 103. An outlet 104 is formed at the edge of the interface between the parts lower part 102 and the upper part 103.

During use, the upper part 103 is pressed downwards in the direction of arrow 105 to actuate the opening of an outlet valve on the aerosol canister and cause the contents of the aerosol to be dispensed through the outlet 104 of the nozzle arrangement 101.

Referring to Figures 2A, 2B, 2C and 2D, the lower part 102 has circular shaped base 201 which is configured to be fitted to the end of the standard cylindrical aerosol canister (not shown). The lower part 102 additionally comprises a centrally positioned actuator portion 202 which is connected to the base 201 by a connection portion 203 which flexible so as to enable the actuator portion 202 to move relative to the base 201. The lower surface of actuator

portion 202 releasably engages with the outlet valve of the aerosol canister during use when the actuator portion 202 is pressed downwards in the direction of arrow 105 (Figure 1). As mentioned above, this causes the contents of the aerosol canister to be released through the nozzle arrangement 101.

The upper surface of the actuator portion 202 forms the abutment surface 204 of the lower part. Formed on the abutment surface 204 is a groove 205 which has an aperture 206 positioned at one end thereof. The aperture 206 aligns with the top of the outlet valve of the aerosol canister and forms the inlet of the nozzle arrangement 101 through which fluid the contents of the aerosol canister access the nozzle arrangement 101 during use. The groove 205 forms part of the wall of the internal passageway of the nozzle arrangement 101 and the opening 207 at the end of the groove forms part of the outlet 104 of the nozzle arrangement 101. Also present on the abutment surface 204 is a horseshoe-shaped recess 208 which encircles the aperture 206 and the groove 205. This horseshoe-shaped recess forms part of a horseshoe shaped seal in the nozzle arrangement 101, as explained further below in reference to Figure 3A. At the two ends of the horseshoe shape recess 208 are two holes 209 and 210. Alignment projections 211 are also formed on the abutment surface 204 of the lower part 102. The significance of the two holes 209 and 210 and the alignment projections 211 will be explained further below in reference to Figures 3A, 3B and 3C.

The upper part 103 of the nozzle arrangement 101 is shown in more detail in Figures 3A, 3B and 3C. Referring to Figure 3A, the upper part 103 has an abutment surface 305 which contacts the abutment surface 204 of the lower part 102 to form the final nozzle arrangement 101. To enable the upper part 103 to align with the lower part 102 so that the abutment surface 305 abuts the abutment surface 204, the upper part 103 is provided with a wall 301 which is configured to fit around the edge of the actuator part 202 of the lower part 103. The appropriate alignment is further assisted by the protrusion rods 302 and 303 which, when the abutment surfaces are brought into contact, are received within the holes 209 and 210 of the lower part respectively, whilst the holes 304 of the upper part 103 receive the protrusions 211 provided on the abutment surface 204.

The abutment surface 305 of the upper part 103 is also provided with a ridge protrusion 306 formed of a resiliently deformable material which, in this embodiment, is a thin layer of moulded plastic. The ridge protrusion 306 forms the remainder of the wall of the internal passageway when the upper and lower parts are brought together to form the nozzle arrangement 101. Referring to Figures 3B and 3C it can be seen that the ridge protrusion 306 is provided a further protruding ridge 307 on the upper surface thereof. The ridge 307 assists in providing the necessary resilience to the ridge protrusion 306 so that it may deform during use of the nozzle arrangement and subsequently return to its original position when the nozzle arrangement is not in use. The ridge

protrusion 306 is shaped to fit tightly into the groove 205 of the lower part 102 (i.e. so that the surface of the ridge protrusion 306 contacts the surface of the groove 205) when the upper and lower parts are fitted together to form the nozzle arrangement 101. When the upper and lower parts are fitted together fitted together, the ridge protrusion 306 resides along the entire length of the groove 205. The effect of this configuration is that the internal passageway is closed when the nozzle arrangement is not in use. However, when the release of the contents of the aerosol canister is actuated, the pressure with which the contents access the nozzle arrangement 101 through the inlet 206 causes the wall of the internal passageway formed by the resiliently deformable ridge protrusion 306 to deform upwards, thereby opening the internal passageway and enabling the contents of the aerosol canister to flow through and be ejected through the outlet 104. In practice it is preferable that the ridge protrusion only deforms to approximately one third of the height of the channel 320 formed on the upper surface of the second part 103. This is to keep the height of the vertical channel between the top of the passageway and the top of the outlet valve (positioned directly below the aperture of the of the lower part 102) to a minimum and hence reduce the amount of product that may be retained in this vertical channel after use.

When the desired quantity of product has been dispensed through the nozzle arrangement 101, the actuation of the release of the contents is stopped by releasing the actuator portion and the resiliently deformable ridge protrusion

then returns to its original position in which its surface contacts the surface of the groove 205. In doing so, the resiliently deformable ridge 306 forces any contents from the aerosol container that remain in the internal passageway to flow out of the outlet 104 or back into the inlet 206.

In an alternative embodiment, the ridge protrusion 306 is provided with a circular protrusion which, when the abutment surfaces 202 and 305 are brought into contact, is received within and "plugs" the inlet aperture 206.

To prevent any of the contents of the internal passageway from leaking and seeping between the abutment surfaces 202 and 305 during use, a horseshoe-shaped protrusion is provided on the abutment surface 305 which, when the abutment surfaces 202 and 305 are brought together, is received within the horseshoe-shaped recess 208 to form a seal which encircles the inlet and internal passageway of the nozzle arrangement 101. In an alternative embodiment, the seal may also extend across the internal passageway (i.e. the groove 205 may be provided with a recess extending across it width which receives a corresponding protrusion on the ridge protrusion 306, or vice versa) to provide an airtight seal when the nozzle arrangement 101 is not in use. The protrusion could be configured to snap-fit into the corresponding recess to form the seal. This may occur due to the elastic force with which the resiliently deformable ridge returns to its original position after use, or alternatively, an operator may have to press the protrusion into the recess.

A perspective view of an embodiment of a nozzle arrangement according to the third aspect of the invention is shown in Figure 4. The nozzle arrangement 400, which is illustrated in the expanded configuration, can be seen to consist of a body having a base part 401 and an upper part 402 fitted to the upper surface of the base part 401.

The base part 401 is moulded from a rigid plastics material and is in the form of a screw-threaded cap. The upper part 402 is moulded from a resiliently deformable plastic and, when fitted to the base part 401 as shown in Figure 4, forms a dome-shaped protrusion on the upper surface of the nozzle arrangement 400, which, during use, can be pressed by an operator, repeatedly if necessary, to cause the fluid to be pumped from the container to which it is attached through the outlet 403.

The base part 401 is shown without the upper part 402 in Figure 5. Referring to Figure 5, the base part 402 has a downwardly extending portion 501, the under surface of which is provided with a screw threaded recess (see Figure 7 and its accompanying description) to enable the base to be screwed onto a correspondingly threaded neck opening of a container (not shown). The upper surface of the base 401 has a perimeter edge 504, which encircles a central recess 502. The recess 502 has a deeper portion 502a shaped substantially like an inverted dome, which extends to form the lower part of a spout-like outlet. In the region of an outlet edge 505 of the base 401 the recess 502 forms an abutment surface 502b. This recess, together with the upper part

402, defines the chamber and outlet passage/valve of the nozzle arrangement 400.

Positioned within recess 502, and just inside the edge 504, is a channel 506, the significance of which will be come apparent in the discussion of Figures 6 below. Also positioned in the region 502a of the recess 502 is an inlet opening 503, through which fluid may access the nozzle arrangement from the container during use. The opening of the inlet 503 is positioned within a further recess 503a, the significance of which will again become apparent in the discussion of Figure 6 below.

The under surface of the upper part 402 is shown in more detail in Figure 6 (for the purpose of illustration, the upper part shown in Figure 6 is inverted). The under surface of the upper part 402 is surrounded by lip 601, which, when the upper part 402 is fitted to the base 401, is received within the channel 506 to form a tight seal between the base and the upper part, thereby prevent any leakage occurring from the chamber or the outlet valve/passageway defined by the base and the upper part (see Figure 5). The under surface of the upper part extends between the lip 601 and is a substantially dome-shaped recess at 602a, which aligns with 502a when the base and upper part are brought together, and extends to form an abutment surface at 602b, which contacts the abutment surface 502b of the base 401 in the assembled nozzle arrangement. The upper part additionally comprises a flap projection 603 which, when the upper surface is fitted to the base 401, sits within the recess

503a and covers the inlet opening 503. The flap projection 603 forms a resiliently deformable flap valve over the inlet 503.

The internal structure and operation of the nozzle arrangement 400 shown in Figure 4 will be better understood by referring to the cross-sectional views shown in Figures 7A and 7B. Referring to Figure 7A, the base 401 can be seen to comprise recesses 701 and 702 on its under surface. The recess 701 comprises a screw-thread (not shown) and is circular in profile so that it can be fitted to a circular screw-threaded neck opening of a container. The recess 702 on the other hand is adapted to receive a dip tube 704 and also extends to form the inlet opening 503. The upper surface 502 of the base 401, together with the under surface of the upper part 402 defines an internal chamber 700 and an outlet passage/valve 703 through which fluid must pass in order to be expelled through the outlet 403. The chamber 700 is defined between the portion 502a of the upper surface of the base 401 and 602a of the under surface of the upper part 402, whereas the outlet passage/valve 703 is formed by the abutment of surfaces 502b of the base and 602b of the upper part. Thus, the upper part 602 forms the resiliently deformable portion of the body which defines the chamber and the resiliently deformable abutment surface of the outlet passage/valve. Furthermore, the flap projection 603 of the upper part is received within the recess 503a surrounding the inlet 505 of the chamber to form an inlet flap valve, as previously discussed.

The chamber shown in Figure 7A is in the expanded configuration and, while the chamber is in this configuration, the abutment surfaces 502b and 602b reside in direct abutment, as shown in Figure 7B, thereby rendering the outlet closed. During use, the resiliently deformable upper part 402, in the region 602a can be deformed downwards by the application of a pressure, for example by the operators' finger pressing this region. The application of a pressure causes the chamber 700 to be compressed from the expanded configuration shown in Figure 7A to a compressed configuration. When the pressure within the chamber exceeds a predetermined minimum threshold value, the abutment surface 602b of the upper part will be caused to deform away from the opposing surface 502b of the base and effectively forms an outlet passageway through which the fluid present in the chamber may pass through and be expelled through the outlet 403 of the nozzle arrangement. It will be appreciated that fluid is prevented from flowing out of the chamber through the inlet by the flap 603. As fluid is ejected the pressure within the chamber 700 will gradually fall as the fluid present within the chamber is exhausted and when it falls below the minimum threshold value the resiliently deformable abutment surface of the outlet passageway 602b will deform back to position whereby it abuts the surface 502b and the and the outlet passageway is closed.

If the pressure applied to the chamber in the region of 602a is then removed, the pressure within the chamber will decrease as the chamber deforms

back to the expanded configuration by virtue of its resilience. This causes fluid to be drawn into the chamber through the inlet, the pressure differential between the inlet 503 and the chamber 700 causing the flap projection 603 to be deflected and thus, causing the inlet to open. Once the chamber retains its expanded configuration, the flap projection 603 deforms back to the position shown in Figure 7A whereby the inlet is closed.

An alternative embodiment of the invention according to the third aspect of the invention is shown in Figures 8A and 8B. This embodiment is virtually identical to the embodiment shown in Figures 4 to 7, as shown by the like reference numerals. The sole difference between this embodiment and the embodiment of Figures 4 to 7 is that the resiliently deformable upper part 402 is connected to the base 401 via a hinge or foldable connection 801 as shown in Figure 8A, which enables the upper part 402 to be folded over to engage the base 401 to form the assembled nozzle arrangement as shown in Figure 8B. In this embodiment, the upper part is formed entirely from a resiliently deformable material, but, in alternative embodiments, the upper part may comprise a framework of a rigid plastic (the same as that of the base) to which a flexible plastic material is over-moulded.

A further alternative embodiment of the invention is shown in Figures 9A and 9B. Referring to Figure 9A, the base 401 of this embodiment is slightly different in form to that of the embodiments previously described in that the upper surface has a dome shaped recess 502a as before, but instead of gently

shelving towards the region of the abutment surface 502b, the abutment surface is instead a flat surface. In addition, the abutment surface 502b in this embodiment has two recesses 901 and 902 connected by a groove 910, which extends from the recess 502a to the outlet edge 505. The abutment surface 602b of the upper part 401 is also a flat surface with a corresponding groove 910 and recesses 901 and 902 formed thereon. When the abutment surfaces are contacted together the respective grooves and recesses align to define a spray nozzle passageway having two expansion chambers (formed by the alignment of recesses 901 and 902 respectively).

In this embodiment the abutment surface 602b of the upper part and the edge 601 are formed from a rigid plastic material and a compatible, resiliently deformable plastic is over moulded to form an initial part of the spray nozzle passageway (which abuts the groove formed in the base to form an outlet valve preceding the spray nozzle passageway essentially equivalent to the outlet valve/passage 703 described in Figures 7A and 7B), the dome-shaped recess 602a and the flap 603.

In common with the embodiment shown in Figures 8A and 8B, the upper part is connected to the base via a foldable connection element 801 which enables the upper part to be folded over and snap-fit to the base 401 to form the assembled nozzle arrangement. In this case, however, the upper part is hinged to the side of the base (rather than the rear, as shown in Figures 8A and 8B).

As before, the dome-shaped recesses 502a and 602a form the chamber 700 when the upper part and the base are assembled together.

In this embodiment, the compression of the chamber 700 is facilitated by a hinged trigger 903, which is integrally formed with the base 401, as shown in Figure 9A. The trigger 903 comprises and aperture 904 which, when folded over about the hinge 905, as shown in Figure 9B, aligns with the outlet 403, thereby enabling the contents expelled from the outlet during use to pass though the body of the handle 903. The handle 903 is provided with a notch 906 which is received within a corresponding recess formed on the upper surface of the upper part 402, again as shown in Figure 9B.

To compress the chamber in this embodiment, an operator will grip arrangement and pull the trigger towards the base 401. This causes the trigger 903 to pivot about its hinge 905 and compress the resiliently deformable upper surface 602a of the chamber 700. The compression of the chamber 700 forces the fluid present therein to pass through the outlet valve 703 when the pressure within the chamber exceeds a predetermined minimum. Fluid ejected through the outlet valve passes through the outlet passageway and expansion chambers defined between the abutment surfaces 502b and 602b prior to ejection from the nozzle arrangement. This produces a spray of the fluid ejected and, in this case, the minimum threshold pressure required to open the outlet valve and eject fluid will be sufficient to ensure that the fluid is forced through the outlet

passage and expansion chambers with adequate force to generate a spray having the desired characteristics (i.e. droplet size, dispersion etc.).

Figure 10 shows a further alternative embodiment according to the third aspect of the invention, which is similar to that shown in Figures 9A and 9B, except that this embodiment comprises two separate chambers formed by the dome shaped recesses of the upper part 402 and the base 401. Each chamber is provided with its own inlet 503 and its own flap valve formed by flap projections 603. This enables two separate fluids to be drawn into the nozzle arrangement from different compartments within the same container. As in Figures 9A and 9B, a spray outlet passage is formed by the abutment of surfaces 502b and 602b, each of which is provided with recesses 901 and 902 and grooves which align when the surfaces are brought into abutment to form two expansion chambers linked by an outlet passageway network. In addition, an outlet valve assembly is provided before the outlet passageway network in each chamber to ensure that fluid only travels through the outlet network when the requisite pressure in the respective chambers is attained following compression.

Referring to Figure 10, it will evident that fluid from the larger chamber passes through both expansion chambers prior to being ejected through the outlet, whereas fluid from the smaller chamber passes through the second chamber only before being expelled through the outlet when the device is

assembled. Thus, the fluids present in the two chambers will be mixed in the second expansion chamber prior to ejection through the outlet 403.

The embodiment shown in Figure 10 is also a trigger actuated nozzle arrangement and the only adaptation to the trigger 903 to that shown and described in reference to Figures 9A and 9B is the provision of two notches 906, i.e. one notch to facilitate the compression of each chamber present.

Figure 11A shows a further embodiment of the invention, which is identical to the embodiment shown in Figure 8A, apart from the fact that this embodiment comprises an air leak valve adapted to permit air to flow into the container from the outside to equalise any pressure differential between the container and the external environment that may exist (but prevent fluid flowing the other way if the container is inverted, for example).

The air leak valve consists of a resiliently deformable member 1101, which is received within an opening 1102 of the base when the nozzle arrangement is assembled, as shown in Figure 11B. The opening 1102, together with the groove 1103 define a passageway through which air may flow into the container from the outside in the assembled nozzle arrangement. The tip of the resiliently deformable member 1101 is provided with a flared rim, the edges of which abut the internal walls of the opening 1102 to form an airtight seal. If a reduced pressure exists in the container as a consequence of expelling fluid through the nozzle arrangement, the pressure differential between the interior of the container and the external environment causes the flared rim of

the member 1101 to deform inwards, thereby permitting air to flow into the container from the external environment. Once the pressure differential has been equalised, the flared rim returns to its original configuration, as shown in Figure 11B. It shall also be appreciated that if the container is inverted, the product cannot leak past the rim of the resiliently deformable member 1101 and any pressure that is applied, by squeezing the container for example, simply pushes the flared rim into tighter abutment with the walls of the opening 1102.

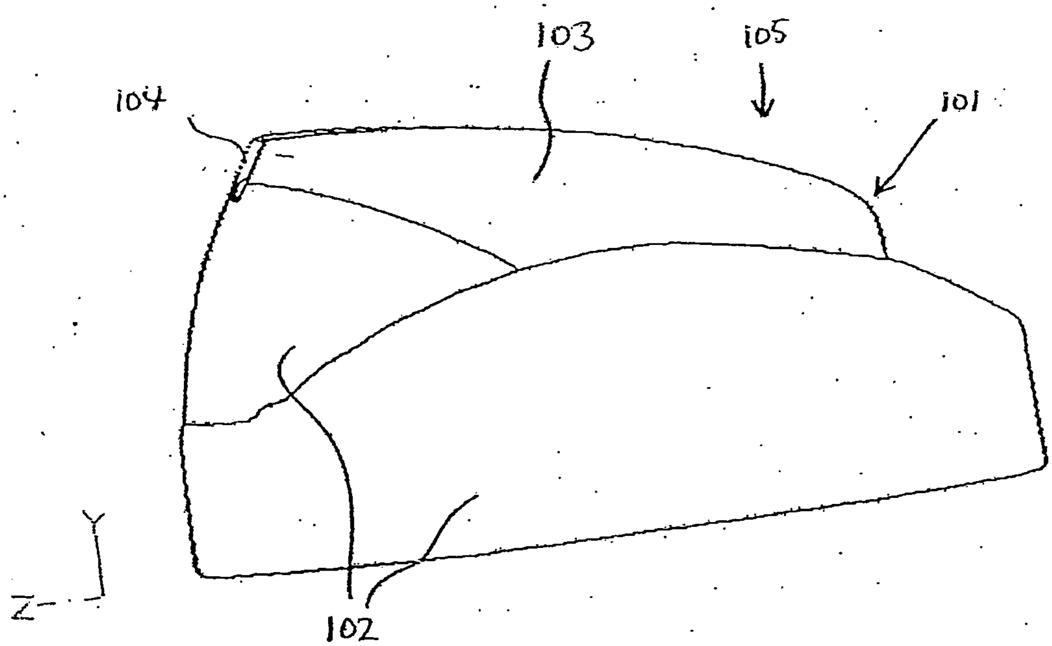
In an alternative embodiment, the air leak valve may be a post or flap positioned within a hole which can resiliently deform to open the passageway when a pressure differential exists, thereby allowing air to flow into the container from the external environment.

In a further alternative, the resiliently deformable upper part 402 could comprise a fine slit above an opening similar to opening 1102. This slit could be configured to open when a pressure differential exists.

In yet another alternative, the air release may be positioned closer to the resiliently deformable upper part 402 and configured such that, when the upper part is pressed downwards to expel the contents present in the chamber 700, the resiliently deformable member deforms in such a way that the air valve is opened, and air may flow into or out of the chamber to equalise any pressure differential that may exist.

It shall be appreciated that the description of the embodiments of the invention described in reference to the figures is intended to be by way of example only and should not construed as limiting the scope of the invention.

Figure 1



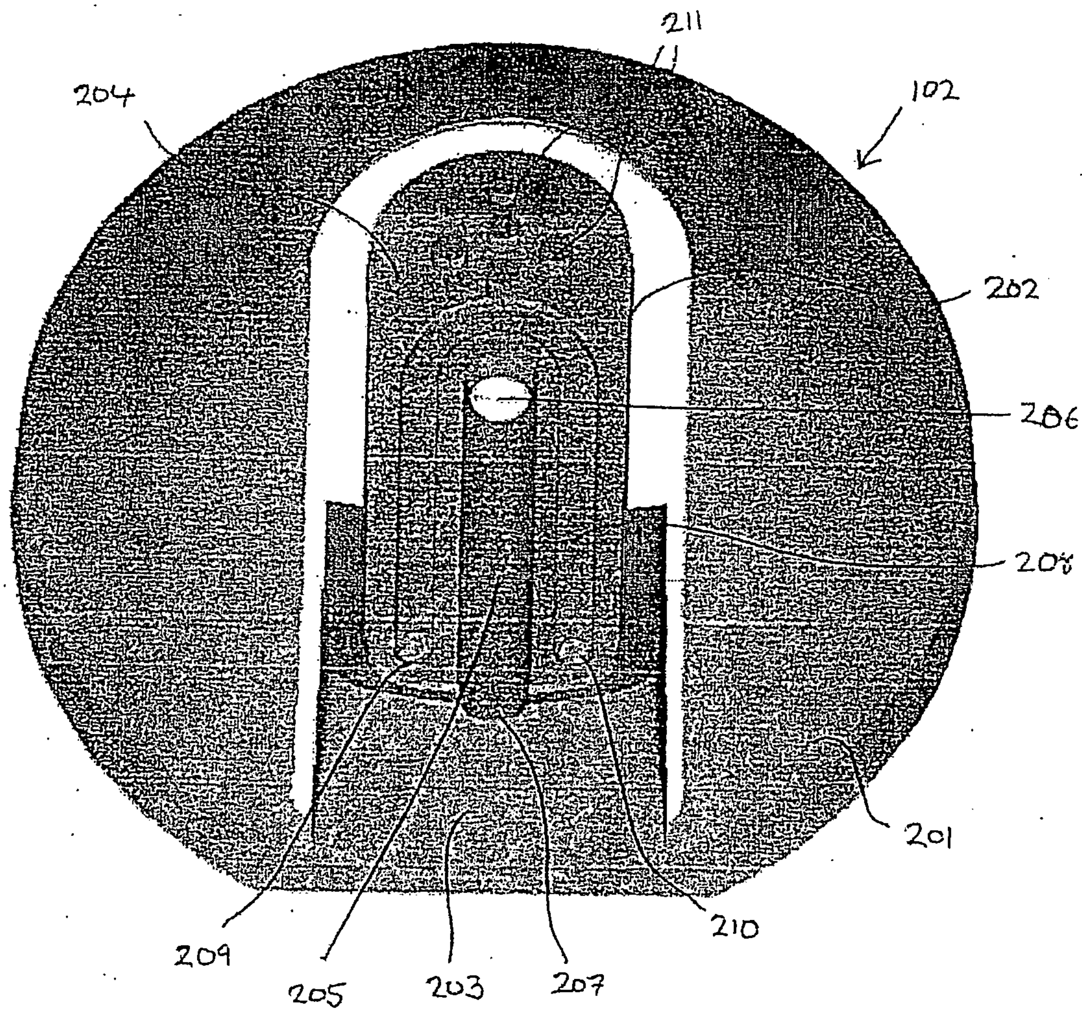


Figure 2A

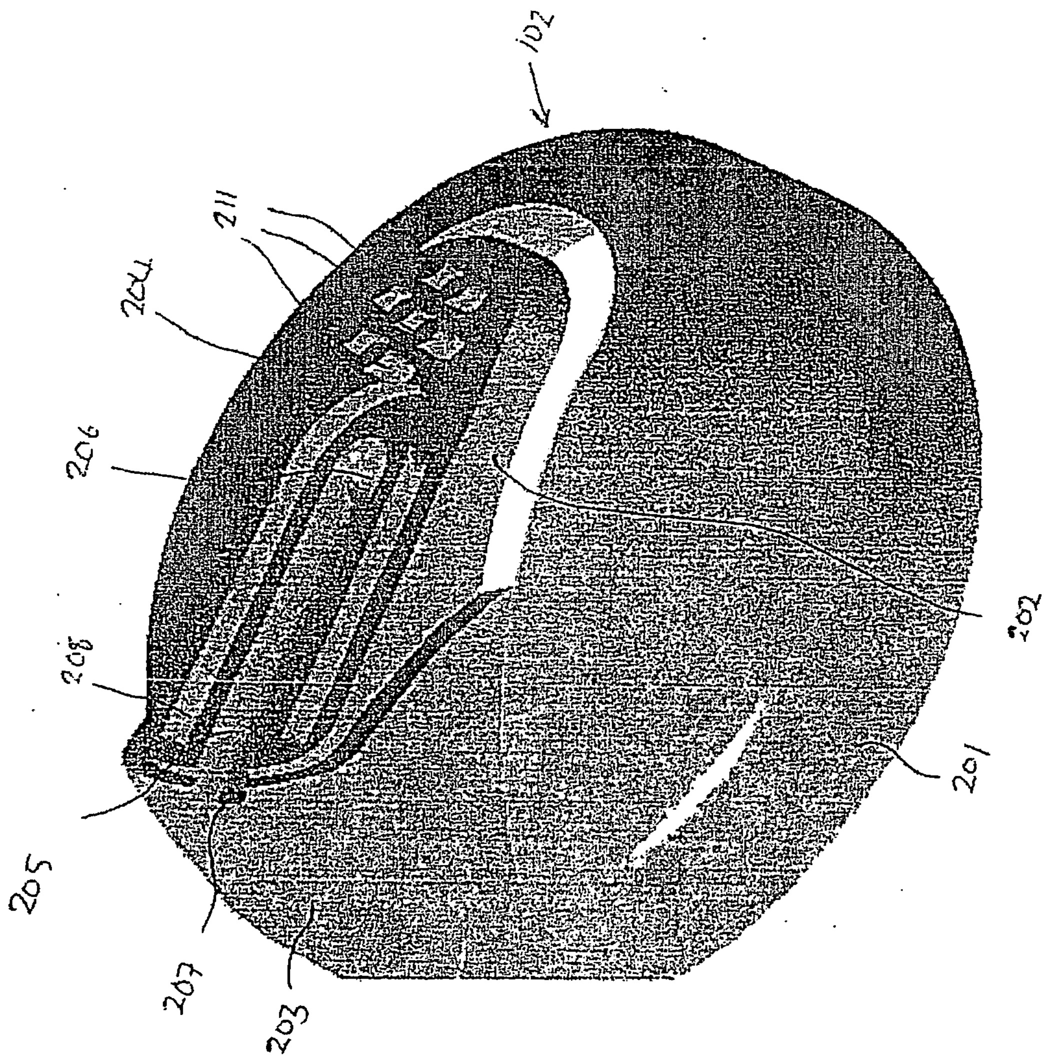


Figure 2B

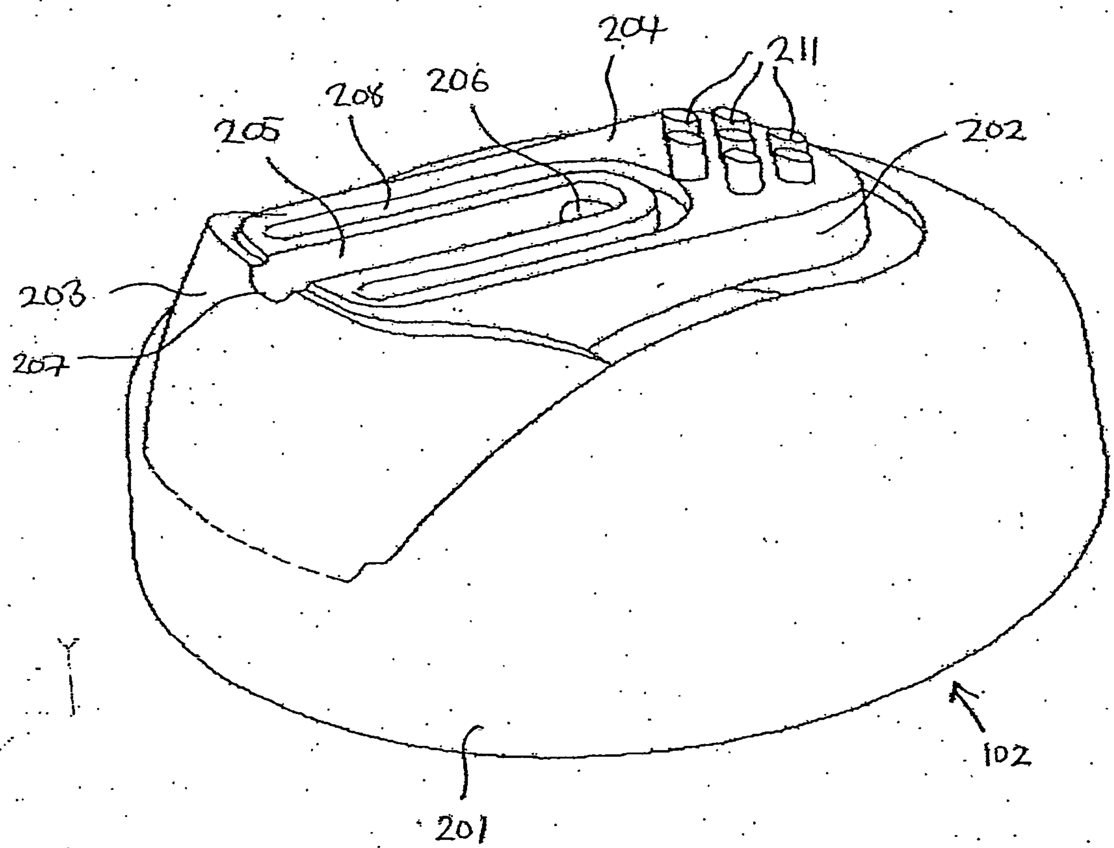


Figure 2C

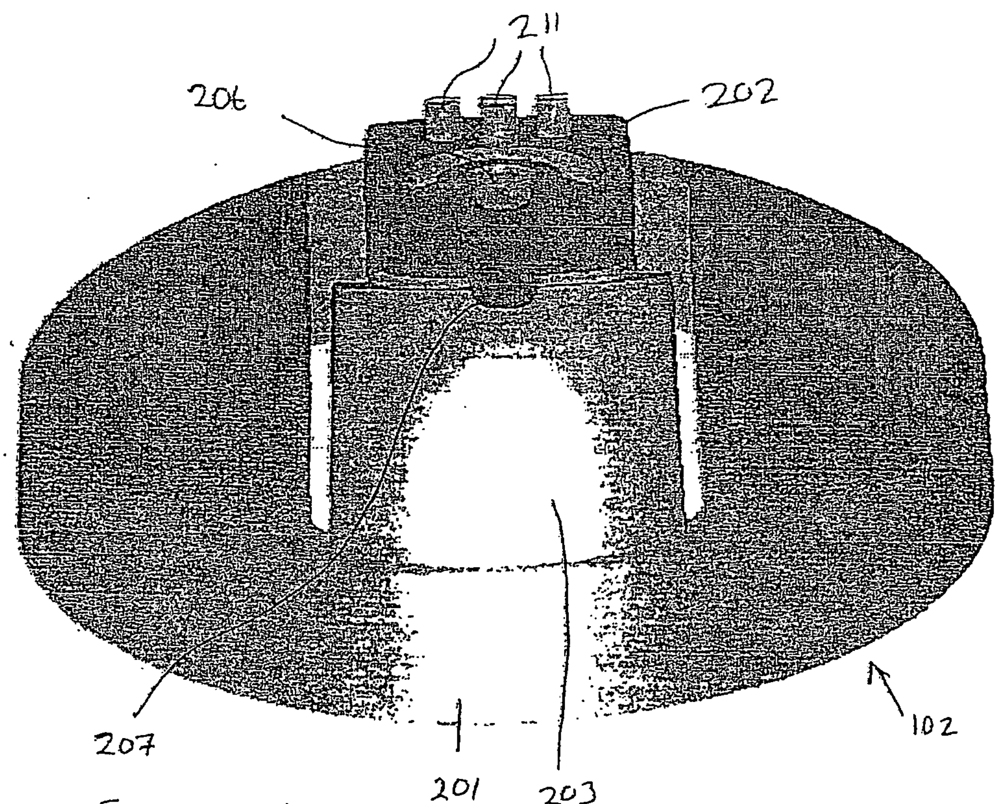
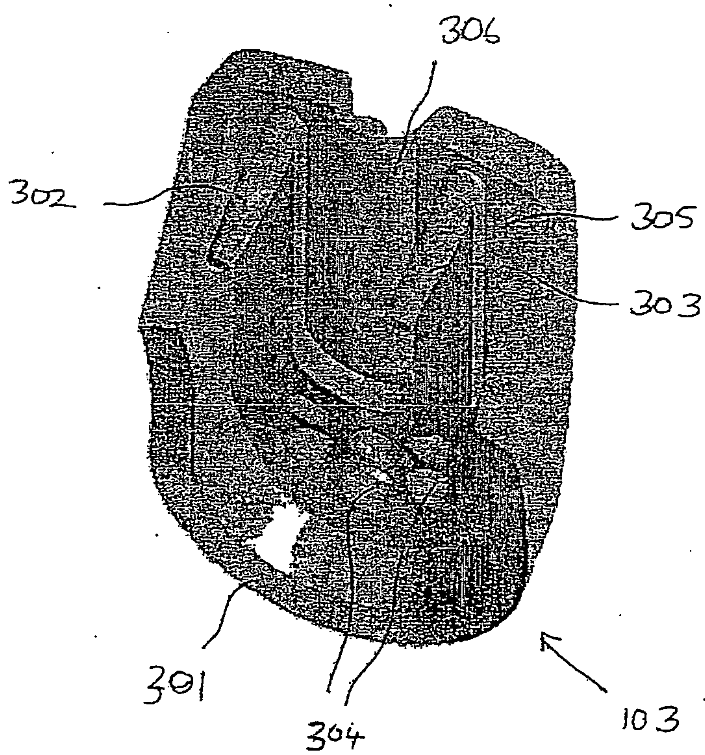


Figure 2D

Figure 3A



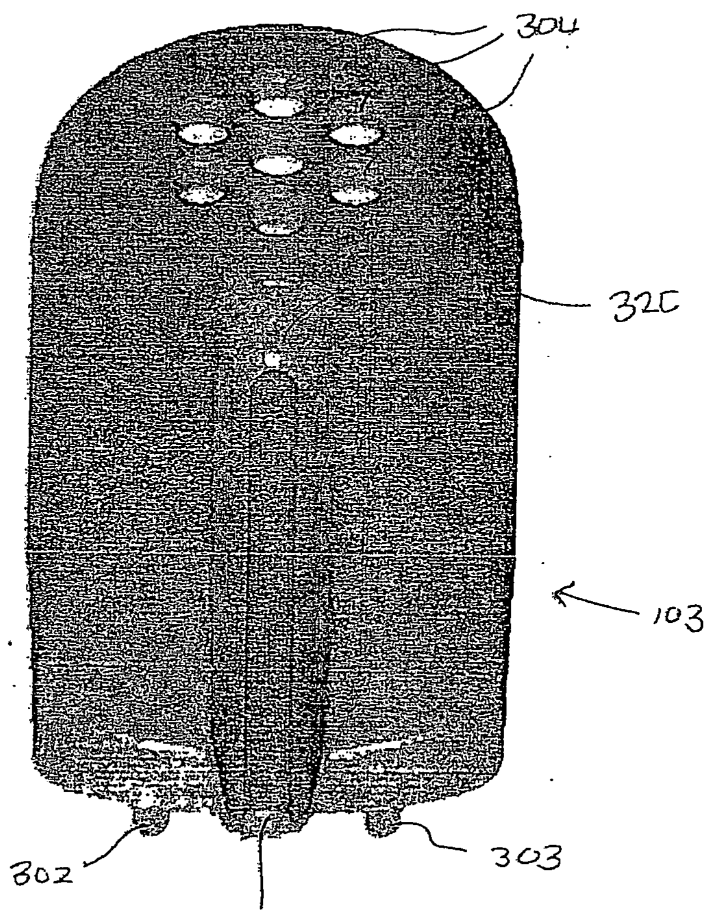


Figure 3B

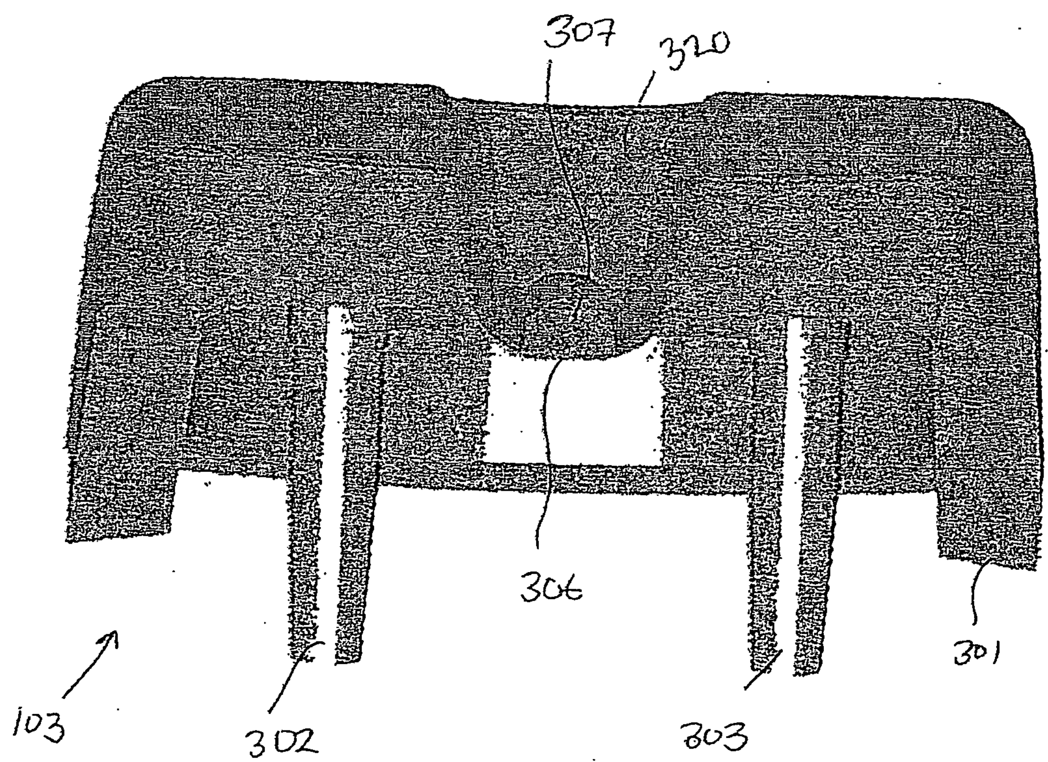


Figure 3C

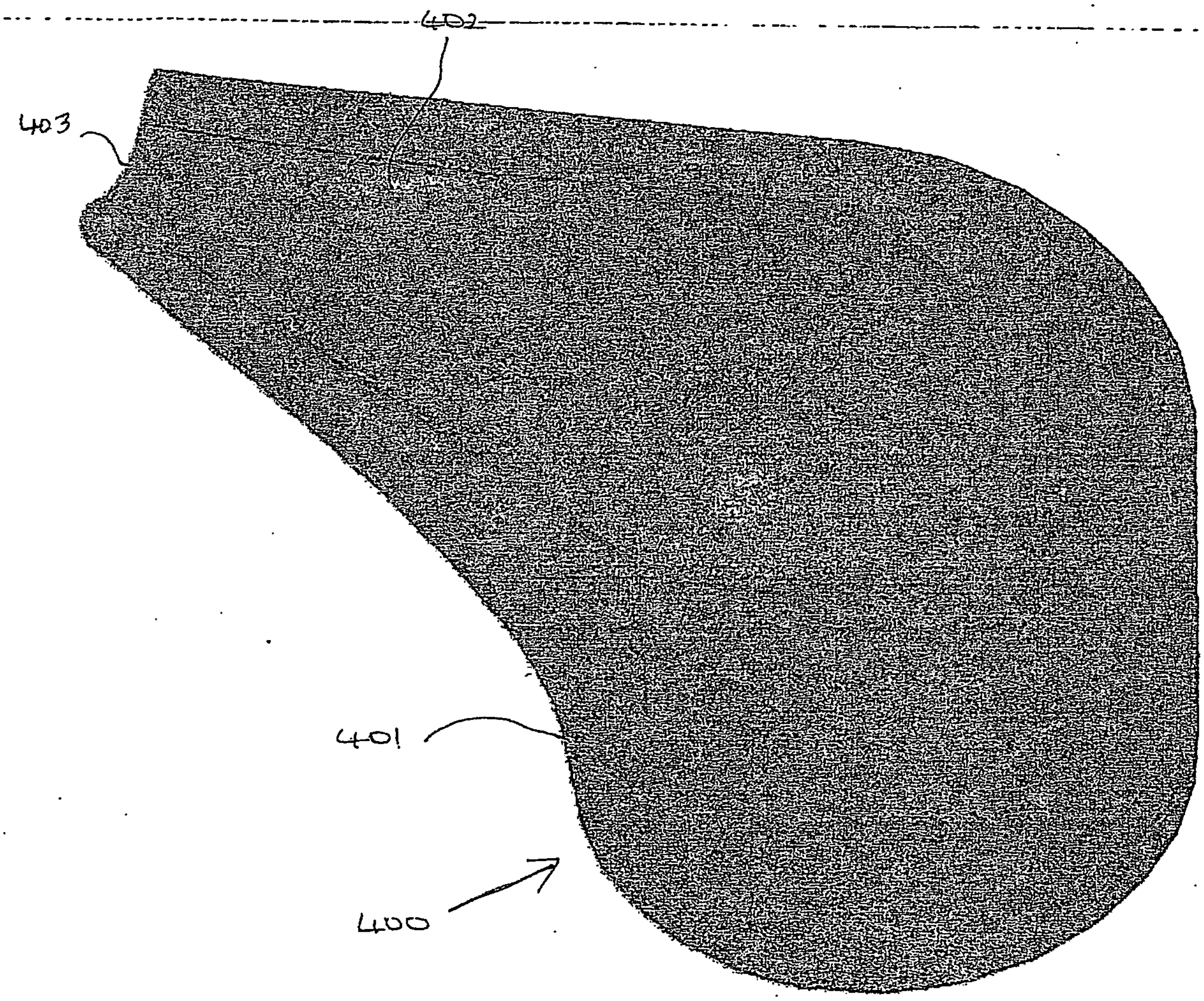


FIGURE 4.

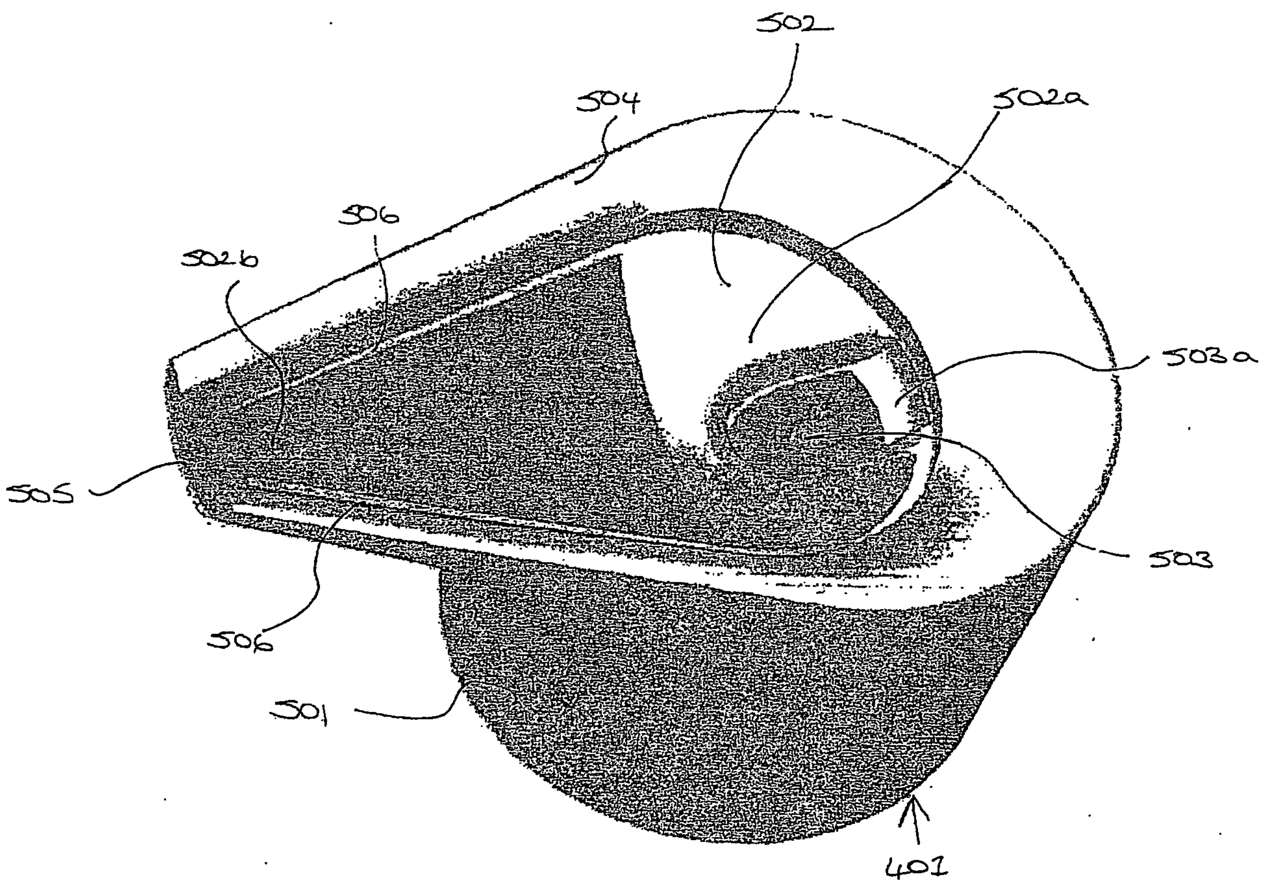


FIGURE 5.

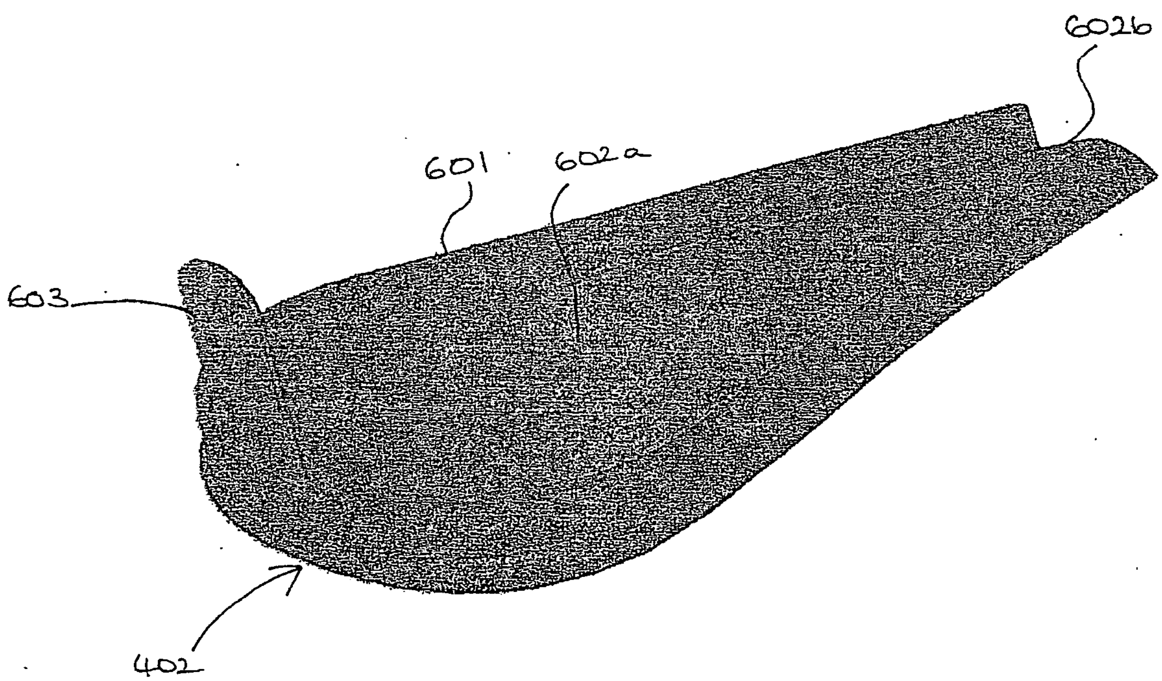


FIGURE 6.

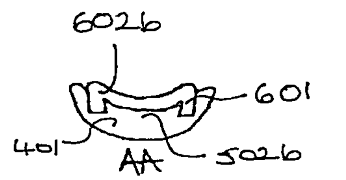


FIGURE 7B.

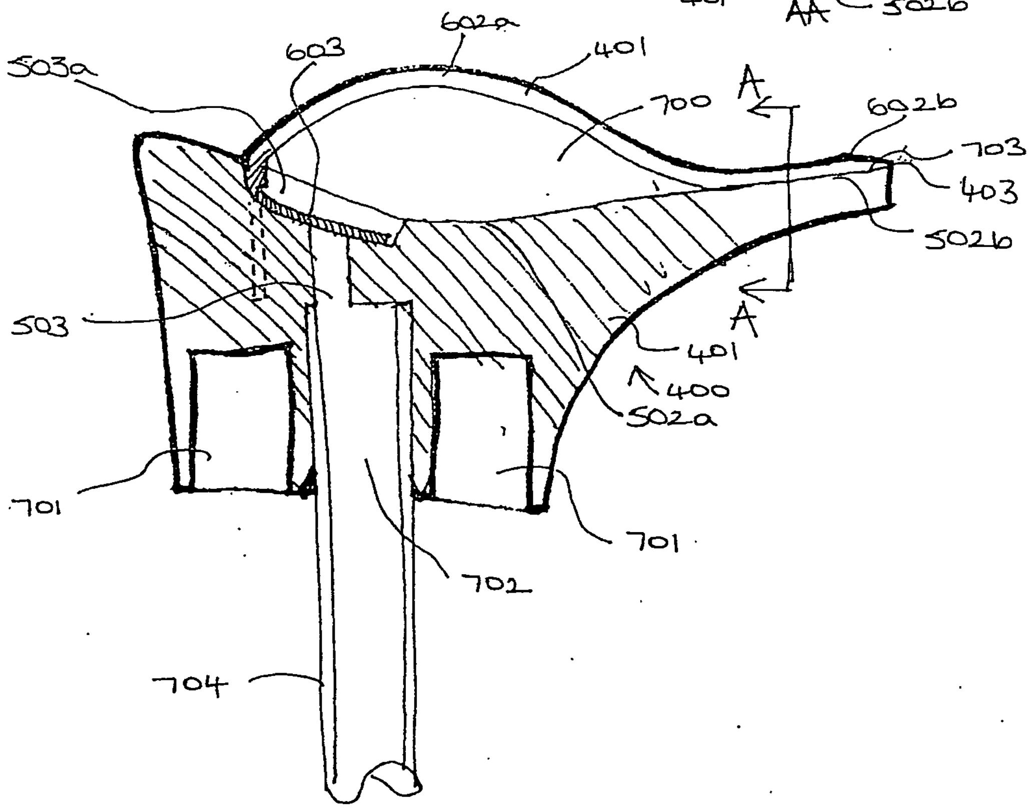


FIGURE 7A.

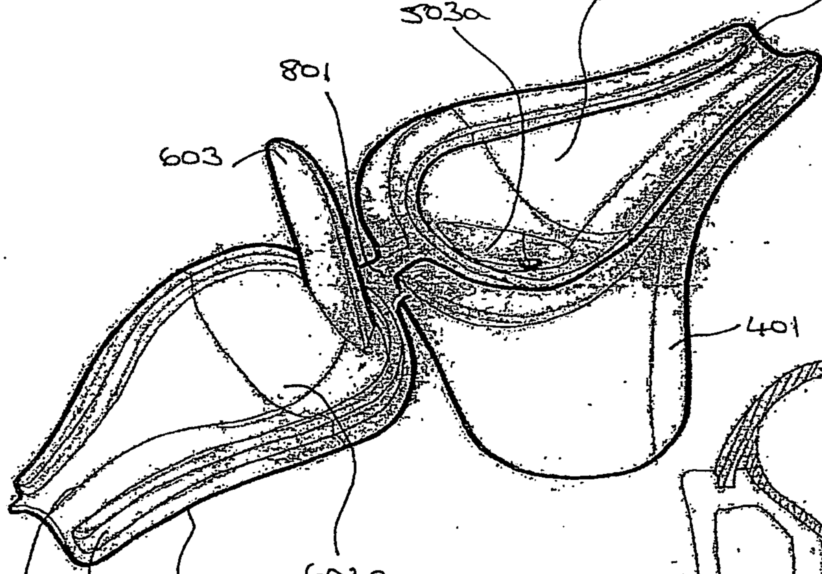


FIGURE 8A

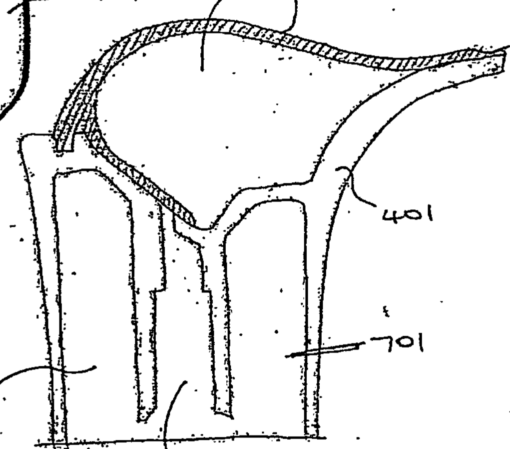


FIGURE 8B

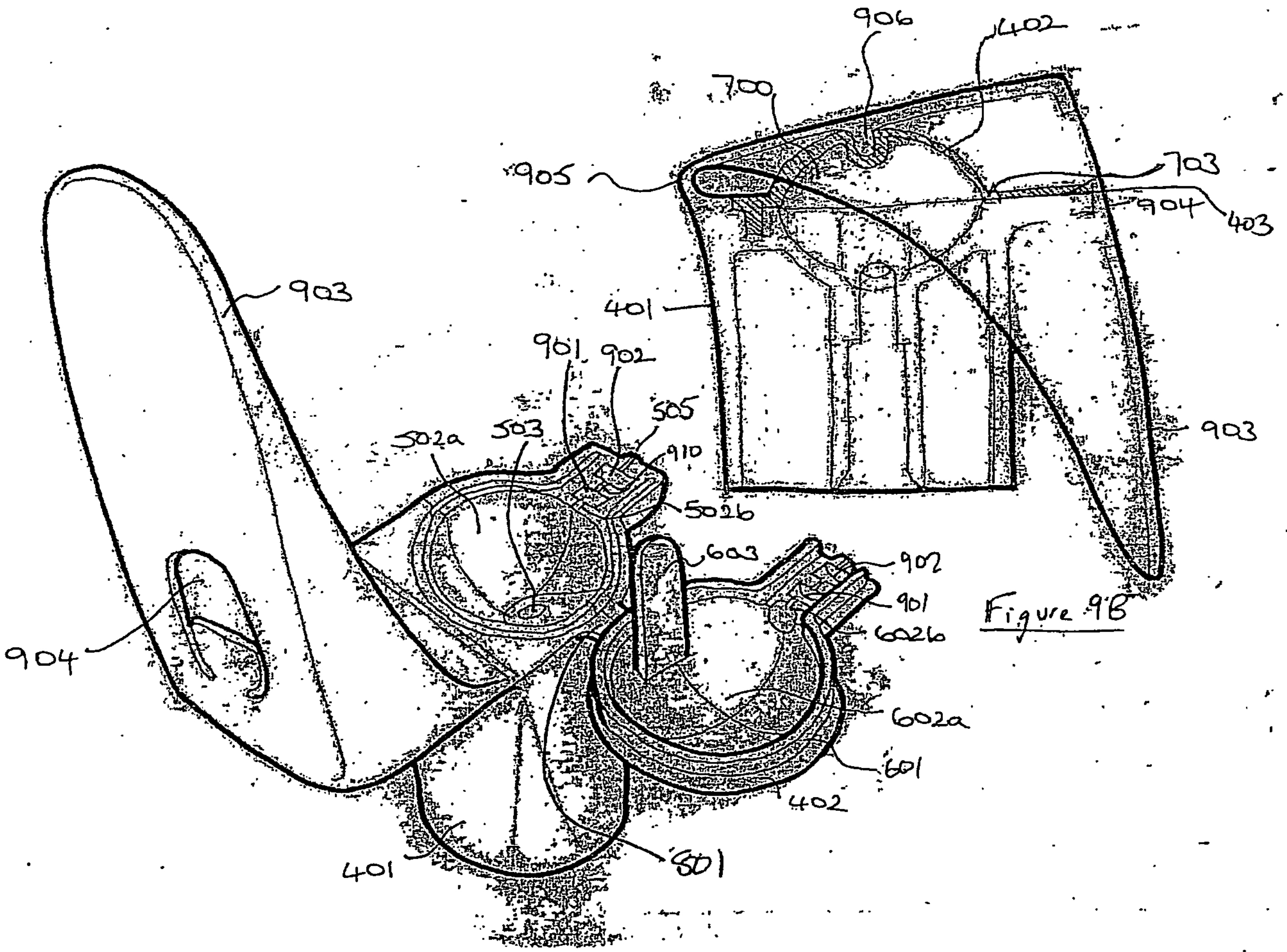


Figure 9B

FIGURE 9A.

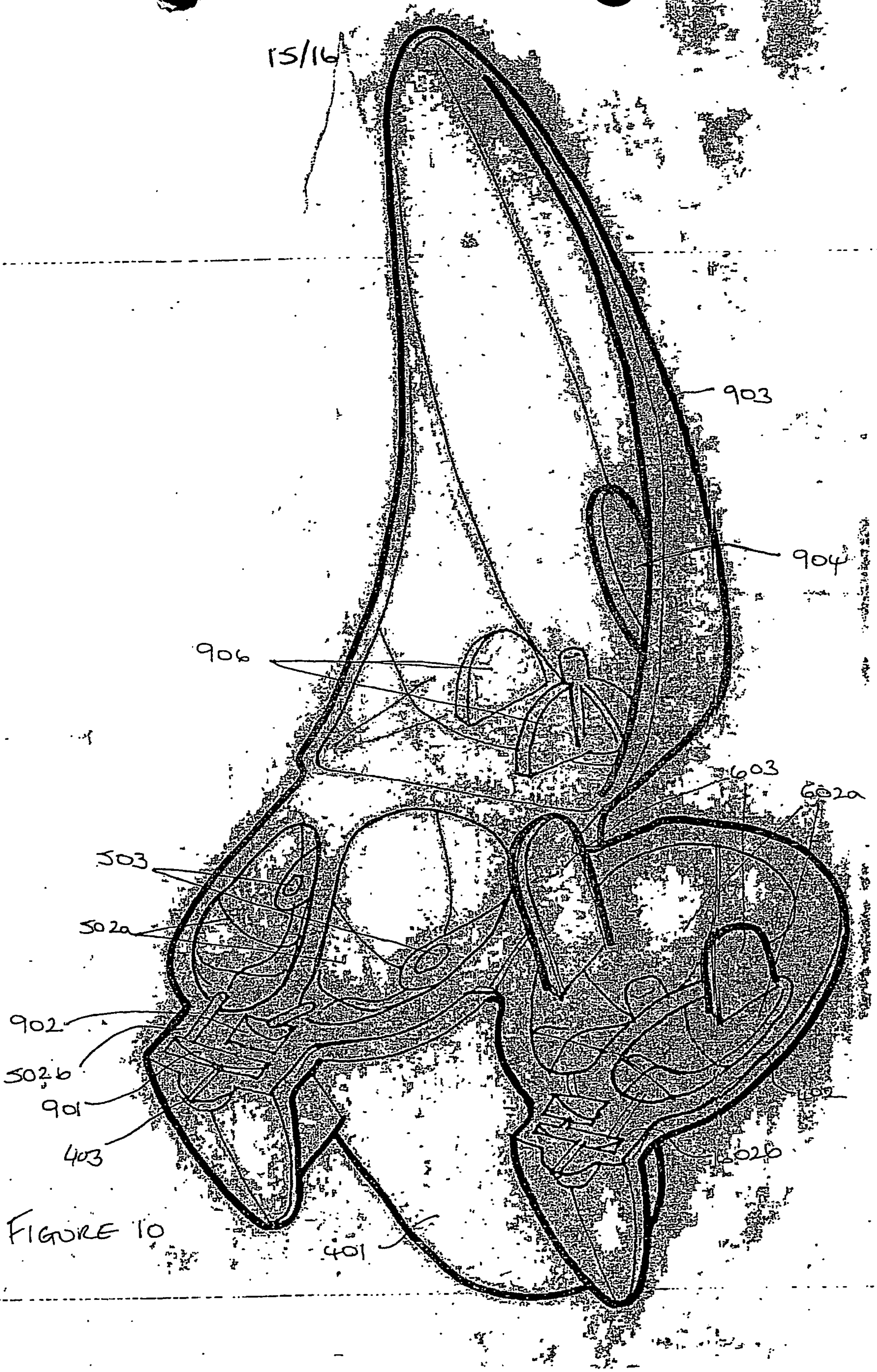


FIGURE 10

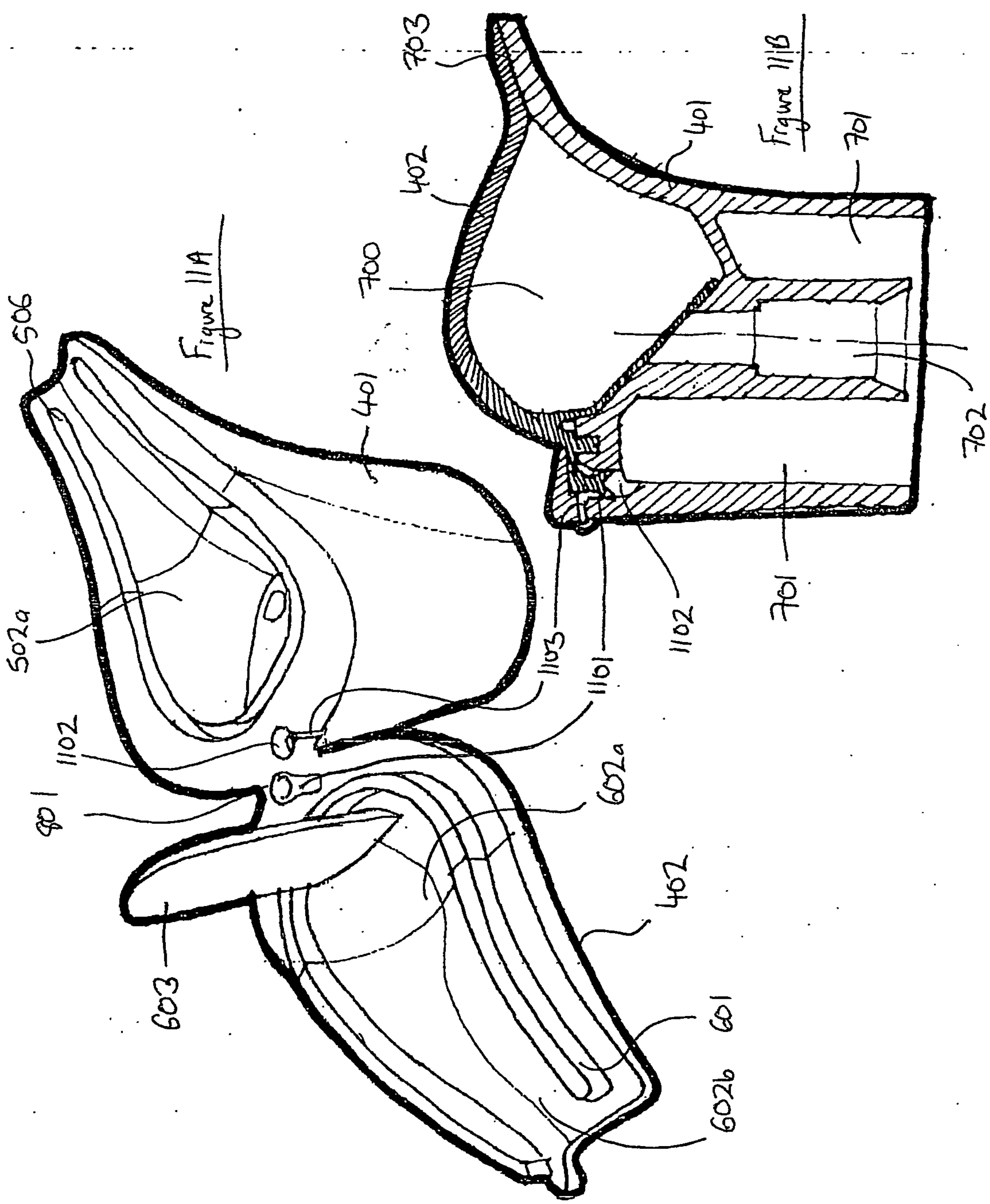


Figure 11A

Figure 11B